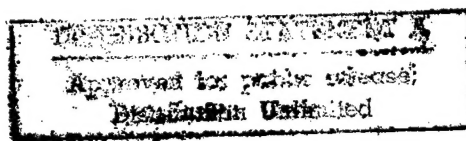


JPRS-EST-93-020  
17 June 1993



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# ***JPRS Report***



# **Science & Technology**

***Europe/International***

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# Science & Technology Europe/International

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## ADVANCED MATERIALS

### Some Viewpoints About Closing the Gap Between Classic Silicate Ceramic Technology and New High-Tech Materials Science in Germany

93WS0411A Arita *PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON FINE CERAMICS ARITA '92 in English Nov 92 pp 21-34*

[Article by Hans Walter Hennicke of the Institute for Nonmetallic Materials, Department for Ceramics and Porcelain Enamels, Technical University Clausthal - Germany, D-3392 Clausthal-Zellerfeld: "Some Viewpoints About Closing the Gap Between Classic Silicate Ceramic Technology and New High-Tech Materials Science in Germany"]

[Text]

#### Abstract

Closing the gap between classic silicate technology and new high-tech materials science means a change in the present curriculum of the education of ceramists. Funding politics of the government must take into consideration the future development of increasing waste recycling, economization of energy and saving of raw materials into consideration. Classical and advanced ceramics are based on the same fundamentals of basic sciences.

#### 1. Introduction

In the early 1970's, the small group of German ceramists was more or less surprised by the exciting impulse of a special of financial support of the governmental research and technology authority (BMFT). The background was the idea to support the development of the ceramic gas turbine for motorcars grant as exhaust gases of that type of engine were less complicated to decontaminate.<sup>1,2,3</sup> Research work to develop ceramic catalyst carriers at some German firms however was not sponsored, so that at that time extruded Cordierit honeycomb structures which are now well known and are even produced in Germany, were able to reach a high standard in the U.S. In Germany, the potential use of nonoxide ceramics of the Silicon Nitride- and Silicon Carbide-group had changed the research concept of some firms which had been related to these materials before as refractory or kiln furniture and to the Max Planck Institute—Pulvermetallurgisches Laboratorium at Stuttgart after having closure of the old Max-Planck-Institut fuer Silicatforschung (1971) at Wuerzburg. Then governmental funding was changed to ceramic components for piston engines. Remarkable in this situation was the increase in publicity in general for ceramic materials but especially for the new high performance ceramics for an increasing number of more or less sophisticated applications.

Now there is a problem of educating ceramists, i.e. ceramic engineers at the universities, in order to cover the whole range of materials. Up to now, looking at the

former West-German States, the so called A-B-C-Universities, Aachen, Berlin and Clausthal, teach a specific curriculum to educate students for a whole range of jobs in industries producing non-metallic inorganic materials, which in Europe are normally divided into Ceramics, Inorganic Glasses and Cements and other hydraulic materials. Historically, this was based on the formation of faculties for Mining and Metallurgy which require supplementary materials for use in a whole range of metallurgical processes.<sup>4</sup> In the former East-German states a very similar development took place at the Bergakademie Freiberg in Saxony,<sup>5</sup> and lead to the continuation of the present intensive cooperation between Freiberg and Clausthal.

Looking at the internal organization of ceramic materials courses, we notice that a rearrangement is now taking place. The generalized multi-field education of ceramic engineers is being shifted towards High Performance Ceramics. Increasingly a doctrine of general materials science is being followed. Clay bonded materials, techniques in mineral processing, classical triaxial whitewares and very often the whole group of refractory materials are becoming less and less the subjects of courses. The most important reason for this is the above-mentioned unilateral funding of research politics which neglects the specific problems of classical ceramic materials. Many people have forgotten the realistic situation that this sort of industry has to provide the money for the taxes the government can spend on research funding! In the large industrial nations research politics are aimed towards encouraging developments in the so-called "High-Tech" areas. The ideas are aiming to progress and solve sophisticated problems of energy saving, clean air and pollution control. Materials science and materials technology have thus found a new identity in the last 10 years despite a very slow realistic acceptance in production.

But we have to understand the interests of young students, who much prefer to take part in the development of new components like space shuttle, new types of car engines or solid electrolytes for advanced batteries rather than investigate the dishwashing resistance of glazes or the thermal shock resistance of porcelain crucibles.

Parallel to this development, a new trend of definitions of the word "ceramics" arises: It is claimed that classical ceramics is discernible from advanced ceramics by looking at the number of presentations about materials at any national or international symposium. This development was noticeable in 1970<sup>6</sup> so that at the XIIIth International Congress 1974, the author dared to give a paper<sup>7</sup> on "What are the prospects for the fine ceramic technology in the future?" We know that there is considerable confusion about the terminology today. In Japan, an appreciated leader in the production and marketing of ceramics, "advanced ceramics" are called "fine ceramics," a term that in Germany traditionally describes several types of fine grained classical silicate ceramics. And, in addition, the advanced ceramics are referred to as high-performance materials, without indicating what sort of performance is meant. A question like this arises if a glaze for tiles with exceptional abrasion resistance could, with every justification, be regarded in their specific application context, as high performance ceramic materials.<sup>8</sup>

## 2. Some Essentials of the Recent Scientific Development

In recent years it has been essential, for the development of ceramic materials, to apply more scientific methods—quite in contrast to the very empirical “trial-and-error” experiments. The methods to look at the microstructure surpassed the possibilities of the optical microscope by other physical methods so that it seems to be difficult to enumerate them all in detail. At present, the broad applicability of microanalytical techniques for microstructural evaluation (Scanning-electron-microscopes in vacuum and room pressure, X-ray-methods, high-resolution transmission-electron-microscopy etc.) are providing a wealth of new information right down to atomic dimensions. These techniques are advancing in an almost incredible manner by the application of all types of computer technologies from main frame machines to personal computers.

The discovery of high critical temperature superconducting oxides by Bednorz and Mueller in 1986 caused a sensation in the field of new ceramic materials and aroused further expectations in advanced ceramics while depreciating the prestige of the classical ceramic production.

It became popular to think that ceramics must have an outstanding unknown potential—an exaggerated speculation which was increased by many optimistic publications, frequently from people who were quite unconscious of the real possibilities for technological realization. Properties like strength were sometimes overevaluated overlooking for example, that the bend strength of coarse refractories is typical opposite to their quality in use.<sup>9</sup>

## 3. Concept for the Curriculum of Ceramists

The author, as a university professor, now asks about a concept to close the gap between these groups of materials—if there is one. You must be aware that the rising generalization of young ceramists must be taught the inherent elements of a wide materials group. In the past, graduates of different disciplines—Mineralogists, Chemists, Physicists and mechanical engineers took up positions in the ceramic industry together with ceramists. We think that a better and broader systematic training starting from basic science should give the students a more convincing motivation and an increased mobility for job selection.

The need to develop a new concept for the curriculum arises from two sides: On the one hand there are many new features to be incorporated in the syllabus, others have to be reduced, and on the other hand, there is a more or less internal German problem to reduce the studying time to a maximum of five years. It must be remembered that our system is strongly influenced by its tradition (see <sup>4</sup>): There is no class system and it is up to the discretion of the student to participate at lectures. Only examinations limit this “academic freedom.”

### 3.1 The German Education of Ceramists at Clausthal

The following two tables will give some more precise information on the curriculum of the last 20 years. The author wants to show here that the numerous new processes of the two groups of materials, classical and advanced ceramics, will complete one another and even influence one another in a very positive way. At the same time, we have to correlate this combination to our educational effort because we all know that the future of our industry as a whole depends upon being able to find excellent and motivated students.

**Table 1. Curriculum University Education for Ceramic Engineers (TU Clausthal 1992) Part I (4 semester = 2 years) (total ca. 1008 hours)**

Main subjects:	hours/week = (netto hours)		
Mathematics 10 (120)	Physics 16 (192)	Inorganic Chemistry 14 (168)	Phys. Chemistry 10 (120)
Electrical Engineering 10 (120)	Mechanics 10 (120)		
Suppl. subjects:			
Data-processing 4 (48)	Mineralogy 5 (60)	Introduc. Ceramics 2 (24)	Techn. Thermodynamics 3 (36)

**Table 2. Curriculum University Education for Ceramic Engineers (TU Clausthal 1992) Part II (4 semester + Theses = 3 years) (total ca. 1080 hours)**

Main subjects:	hours/week (netto hours)		
Glasses 7 (84)	Ceramics 8 (96)	Cement, Lime, Building Materials 8 (96)	Technical Thermodynamics, Heat transfer, Kilns 7 (84)
Mathematics 2 (24)	Phys. Chemistry 7 (84)	Raw Materials, Geology 5 (60)	Technical Processing, factory 10 (120)

Suppl. subjects:

Laboratory practice 16 (192)	Refractories 2 (24)	Machinery f. Production 6 (72)	Free choice 12 (144)
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In addition: a) Practical training in industry (3 different type) 6 months, supervised by written reports. b) Exercise thesis, experimental 4-6 weeks supervised in the university or industry. c) Diploma thesis, experimental in the university or industry (supervised) 6-8 months.

Approximate academic year: Summer semester: April 1-July 15 (12 weeks effective). Winter semester: October 15-February 15 (12 weeks effective).

Netto: ca. 24 weeks for lectures p.a.

### 3.2 Some New Evolutions in Ceramic Materials and Technology

#### 3.2.1 Raw Materials

Over the years the classic raw materials increasingly gained their own technologies and market for purified materials, so that the ceramist has concentrated on the efficient control operations. Now, rapid chemical analysis by X-ray-fluorescence, grain size distribution, flow curves and rheological behaviour are better instrumentally underlined. We restrict the extended teaching in geology and mineralogy to a minimum in some basic knowledge, but the teaching of crystallography must continue.

A main basis for the new ceramics is the introduction of chemically synthesized powders and one of the headlines is related to sol-gel-processes. This knowledge is more than 100 years old (Ebelman 1846) and in Germany, there have been groups of chemists (H. Staudinger - R. Schwarz - E. Thilo 1924-1956) working on the atomic structure, mechanism and type of chemical hydrolysis to gel formation. But nobody remarked on the possibility to create a powder source. At the present time, the chemical route for powder production is well known.<sup>10</sup> The powder production by calcination, solid state and solid-gas reactions, arc melting processes continues but it suffers from the economic limitation of prices for starting materials and manufacturing costs. One idea for the future could be to use such sinterable powders as reactive additions in classical ceramics as bonding agents for coarser grains.

#### 3.2.2 Reactivity of Materials

One of the first things for a beginner to learn in the science of materials is that the synthesis or reactions at high temperatures are related to the complicated correlation of mechanical softening (for a chemist: the melting point) to the test and service conditions. These reactions are not only described by temperature, time, transport reactions and/or mechanical stresses (sintering stresses) but also by atmospheric conditions (generally the oxygen partial pressure, usually simply referred to as oxidizing or reducing conditions). A subsidiary subject, but very important for refractory materials in metallurgical applications, is the corrosion reaction by slag, dust and special atmospheres. Nevertheless, it is a fruitful idea to use the purity of raw materials and powders not only for their classification but also for the intensification of research into the various influences of, and reactions with, minor constituents. In all cases this is influenced by a serious economic aspect for a student in ceramics has to understand certain market fundamentals.

Equilibrium and non-equilibrium phase diagrams are a basis for defining the reaction path towards the final state using principles of local reacting components. In this way it is fruitful to reduce the number of components by reasonable combinations so that existing equilibrium diagrams can be used. At the university the theory of such diagrams and the practical application

must be accompanied by an intensive seminar concentrating on individual questions of understanding. This and kinetics of solid state reactions have to be considered in lectures of applied physical chemistry for ceramists and will serve for classical and advanced materials. Impurities usually decrease the melting temperature but exceptions are possible when solid solutions are formed or the densification kinetics is influenced by liquid/solid reactions. Sources are not only raw materials in natural minerals but also the additions during chemical processing. Examples are boron oxide content in seawater magnesite, the ash content of natural graphite, the sodium content in calcined alumina, and all materials with deleterious influences. It is worth remarking that in some cases impurities are useful or even necessary: For stabilizing certain compounds (trivalent ions in Zirconia, Silica in Aluminium Titanate), as sintering aids (Iron Oxides in Magnesite, Titanium Oxide in Chromium Oxide) or even as reactive additions (additions of carbon bearing compounds to silicon carbide, minor iron contents for the nitridation of silicon, or the alloying of aluminium meltings for the DIMOX process).

#### 3.2.3 Microstructure, Particle Packing Characteristics

In contrast to one-component-systems which are very typical for high strength structural ceramics, microstructure in classical ceramics is complicated by the porosity. This problem overlaps all ceramic materials and is sometimes undervalued. Pore sizes and size distribution have a remarkable influence on all physical properties and on possible applications. I dare to say that a ceramist needs to be a specialist in pore microstructural effects. This is in some of ceramic materials, in refractories so decisively important, that satisfactory methods for quantifying working in a wide range are interesting for a better understanding. The problem is compounded by the fact, that in coarse materials pore sizes range from  $10^{-2}$  m to  $10^{-11}$  m (i.e.  $10^{-2}$   $\mu$ m).

#### 3.2.4 Forming Methods

The microstructure of sintered materials is preceded by that of the green, porous state which is also influenced by the grain size and size distribution of raw materials and by many parameters of forming process. The former molding operations using the plasticity of clay minerals for slip casting, plastic forming or semi dry pressing are completed by organic additives up to pure organic liquid systems used in injection molding, tape casting, extrusion. In these cases the principles of classic rheology are applicable, so that a young ceramist may compare the typical time dependent interparticle effects of electrostatic or steric stabilization. New processing techniques have been developed to overcome the inherent difficulties of porosity: melt oxidation, chemical routes for metallorganic precursors, the way from cold isostatic pressing to hot techniques (HIP) and gas pressure sintering. As a rule, the more complicated the process may be, the more limited may be the specific application. Forming methods are not at all exhausted and the practitioner will invent new variations. In the education of

students this means working in industry itself in order to learn by doing. The role of an intelligent supervisor, visiting and discussing with the student, is important. (above the curriculum problem).

### 3.2.5 Drying and Firing

The enormous advantages of accelerating drying and firing in the operating procedure of the whole ceramic process was recognized 20 years ago. It started from relatively equal sized products of the Italian tile industry. At the present, rapid firing and drying is discussed in all branches of the ceramic industry. For the firing of some types of refractories, containing carbon, or for hard porcelain, soft ferrites and control atmospheres under reduced oxygen, partial pressures are essential. Devices based on zirconia solid electrolytes are now available. This demonstrates the use of sensors as an example of new devices. A small group of special products of recrystallized silicon carbide or sintered silicon carbide and nitride are fired in electrical induction or resistance furnaces. Research indicates that microwave energy offers many advantages over conventional heating methods in ceramic processes.<sup>11</sup> For example,

since power is only deposited into the body to be heated, the surrounding air remains cooler than the body. This results in the creation of an inverse temperature profile, that is a higher internal than surface temperature. So much more uniform temperature profiles during heating may also be achieved by combining surface heating techniques with microwave heating. However, to understand the specific origins of heating effects the ceramist is forced to learn much more about the dielectric behaviour of complex materials in heterogeneous microstructures. Lectures on electro-ceramics could be extended. A similar access could be found to ceramic sensors. On the one hand, the classical ceramist is a consumer, but he must also be interested in the background of the operating mechanism. Just here I may show that the gap between materials as a sort of bridge between the intelligent consumer and the materials specialist must be closed by a new concept in teaching.

### 3.2.6 Materials Properties

Looking at a weighted importance of materials properties between classical and advanced materials it may be helpful to classify properties other than on a typical physical basis. Table 3 gives some ideas about this.

**Table 3. The Importance of Properties for Classical and Advanced Ceramics. \* = most important group in this property group (biological and nuclear functions are not taken in consideration)<sup>15</sup>**

Functions (main properties)	Materials (classic (advanced))	Examples
Aesthetic and Ornamental	*Clay bonded Ceramics	Pottery, Hard Porcelain, Bone China, Architectural
	Thin film film	Decoration
Utility, customary, Home, Civil	*Clay bonded triaxial Whitewares	Sanitary ware, Sewage pipes, dinnerware, cookware
	(Glass ceramics)	dinnerware, cookware
Electrical	Steatite, cordierite	Triaxial bodies, High/Low-Tension
	*Electroceraamics	Many compositions
Magnetic	non relevant	
	*Ferrites	Hard/Soft Magnetics
Optical	non relevant	
	*Oxides, (translucent), PLZT etc.	Many compositions
Chemical	Stoneware, Technical Whitewares	Mat.f.Chem. Plants
	*Many spec. Materials	Sensors. Carrier
Thermal	*Refractories	Many compositions
	Radiators, Exchangers	spec. Materials
Mechanical	Heavy Clay Prod.	Bricks, Linings
	*Many spec. Applications	Special Ceramics

### 3.2.7 Waste Recycling

In Europe, new processes are emerging for avoiding or applying waste materials by recycling. The first group is related to new processes of fabrication, for example to glaze by dry processes (powder process underlined by electrostatic forces<sup>12</sup>). Another type of experiment tries to open an internal circle of waste materials and water to reduce costs and governmental taxes.<sup>13</sup> New problems

will rise if waste materials from other chemical processes were to be incorporated in ceramic materials. The ceramist has to know new specific properties of the waste material in addition to the new reactions in the clay system. Hazardous muds can contain heavy metals,<sup>14</sup> but by sintering to dense stoneware bodies (up to 20 weight % addition) a useful material for floor tiles can be produced. I think that this sort of development will increase in the future. The classical ceramics will play an



important role in the near future. The cost for bringing waste materials to a dump are increasing rapidly. This is so influencing many economic balances that new processes are being made possible.

#### 4. Conclusions

It can be shown that the gap between classical and advanced ceramic materials, originated by a one-sided governmental funding, can be united by a change in the present curriculum. In the classical ceramics the research and development will be conducted more within the individual firm, which is much more characterized by process engineering than by materials development. Public research institutes may be usefully engaged in complementary studies for the validation of materials and for standardization. In my university our experience shows interesting results of any cooperation of a public materials testing department with a university institute.

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#### UK: Properties, Applications for New Synthetic Rubber Discussed

93WS0439M Toddington NEW MATERIALS  
INTERNATIONAL in English Feb 93 pp 2, 3

[Text] A new generation of synthetic rubber compounds will greatly increase the working life of dynamic and static seals used in petrochemical processing and oil production—especially where explosive decompression is a problem. The new compounds are also formulated for seals in hydraulic systems and plant handling abrasive or chemically-aggressive media at high temperatures.

Developed in the UK by James Walker, these high-performance hydrogenated nitrile (HNBR) compounds will, according to the company, outperform all standard nitrile (NBR) elastomers. Their longer life under arduous conditions will cut maintenance costs and enable plant operators to combat fugitive emissions with greater efficiency.

The new material combines tensile and tear strength with abrasion resistance. The compounds are resistant to oils, aggressive fluids such as steam, most hydrocarbon fuels, sour (H<sub>2</sub>S) crude oil, methanol, acids and alkalis, oil additives, amine corrosion inhibitors and ozone.

James Walker manufactures 12 of these new Elast-O-Lion compounds. Three of these are designed for oilfield duties. They have explosive-decompression (ED) resistance to withstand high pressure cycling, and can work continuously in sour crude at temperatures up to 180°C. These compounds have medium, high or ultra-high acrylonitrile contents to give various hydrocarbon resistance levels and low-temperature properties. They also survive prolonged contact with many oilfield media which attack fluorocarbon (FPM) elastomers—the main ED-resistant seal materials used by the oil industry.

The other nine compounds are for general industrial and process duties where ED-resistance is not needed. They come with the same acrylonitrile levels but range in hardness from 65 to 90 IRHD. Applications include

dynamic seals for abrasive or aggressive media, and static seals where extrusion resistance is essential. Temperature limit in oil is 170°C continuous.

Details from James Walker & Co Ltd, Lion Works, Woking, Surrey GU22 8AP, UK. (Tel: 0483 757575; Fax: 0483 755711.)

### **French Automotive Researchers Develop Amine-Free Backing Foam**

*93WS04390 Toddington NEW MATERIALS INTERNATIONAL in English Feb 93 p 5*

[Text] Peugeot's latest 405 passenger car has a redesigned dashboard with an ABS former covered by a slush moulded PVC skin. It is backed with a semi-rigid polyurethane foam to bond together the whole assembly and provide a higher quality finish. Automotive moulder Reydel worked closely with ICI Polyurethanes to develop a special amine-free backing foam system to meet the car maker's specifications.

Reydel is a major French automotive component moulder with factories in several European countries. Dashboards for the restyled 405 are produced at its plant in Gondecourt, near Lille in the north of France. Regular output is around 500 units a day.

Production is carried out on a new seven-station OMS carousel using a Krauss-Maffei Rimstar 16 dispensing system. Dashboards are backed using open-mould pouring. The unit is equipped with an Albora two-axis robot to control the pouring pattern of the high pressure mixing head.

Peugeot specified either an amine-free or amine-blocked foam system to reduce heat aging and windscreen fogging problems caused by interaction between the PVC skin and amine catalysts. Amine-free systems from ICI offer resistance to embrittlement and staining.

Furthermore, according to Xavier Wallart, production engineer at the Reydel plant, these systems offer an enhanced reaction profile over previous amine-containing systems. Mould temperature tolerance is also improved.

Technical specialists from the ICI European automotive RMC (regional market centre) in Everberg, Belgium, worked closely with Reydel personnel in Gondecourt to meet the needs of the new production system. Cycle times and the reactivity profile have been optimised.

Two dashboard models are produced for the Peugeot 405, the main difference being an additional duct for an air-conditioning option. Two different moulds are necessary for the foam backing operation but, by careful mould design, several units can be used for both options through the addition/removal of an insert. This has made it possible to reduce the number of tools to a minimum.

Both the slush moulded PVC skin and the injection moulded ABS former are produced in-house. The resulting composite unit undergoes full quality control after foaming before passing to final assembly for addition of all other elements.

Amine-free semi-rigid polyurethane foam systems from ICI can be processed by both open mould pour and closed mould injection techniques. They can be used for backing either vacuum formed ABS/PVC foils or slush moulded PVC skins.

Processing advantages include good flow and adhesion, high packing density where required, rapid demould times and minimum scrap rates. The foam serves as a highly efficient adhesive, binding together the cover material and the internal armature, resulting in a lightweight but structurally strong sub-unit ready for fitting out.

### **UK: Materials R&D, Design, and Prototyping Center Opened**

*93WS0441C Toddington NEW MATERIALS INTERNATIONAL in English Apr 93 pp 4-5*

[Text] AEA Technology has opened its Advanced Materials and Manufacturing Technology Centre in Harwell.

The facility, which represents an investment by AEA of £4 million, claims to offer industry cost-effective support throughout the design cycle, from the development of new materials to the design and production of prototype components.

The new facility will house the Advanced Engineering Materials Department and will bring all materials fabrication research under one roof. The department, in its new building, aims to help bridge the gap between fundamental research into materials and industrial scale manufacturing—a crucial element in innovation.

The new facility contains a newly-purchased Davy United rolling mill which will enable AEA to undertake production-scale development for its customers.

The work of the Centre could be important as companies, especially small and medium size enterprises, are often reluctant to invest in what they regard as unproven technology. They may be afraid of the risks involved and the high cost of failure. Centres like AEA can offset some of that risk by demonstrating processes developed from existing technology, using equipment such as the Davy mill to scale-up research work.

Dr. Stuart Nelson, managing director of AEA Technology's industrial business group, said: "Technology transfer means many things, but it is not generally about producing completely new products—in some cases, these can take many years to provide a return. It is more about applying known technology to improve existing processes and products, or to help companies respond to increasing safety and environmental legislation.

"To be truly effective, we believe that technology transfer must be performed as a profitable business—it is only then that we get the right market and customer focus," he said.

With a turnover of £400 million and staff of 8,000 AEA Technology is a diverse scientific and engineering services business. As well as a major contractor to the international nuclear industry, it supplies clients in process, transport, manufacturing, utility and oil and gas industries worldwide with technical products and services and consultancy in everything from advanced engineering materials to environmental protection.

The Advanced Materials and Manufacturing Centre offers comprehensive metallurgical facilities including two rolling mills sized to bridge the gap between laboratory and full-scale production (36-in-wide Davy United plate mill and a Sir James Farmer Norton rolling mill with a 17-in back-up rolls and 6-in work rolls). Capable of small and intermediate-length specialty runs, they offer a perfect complement to in-house facilities.

The Centre also specialises in a range of materials from metal through to polymer and metal matrix composites and ceramics. And further up-stream, it is intimately involved in the development of the next generation of new materials, including smart structures and high temperature superconductors.

Closely linked to the new Centre is a range of surface engineering services for industry. These include ion implantation which involves bombarding surfaces with ions. For example, the technique is used to improve the wear resistance of high performance racing car components like crank shafts. Where these are made of steel, tungsten carbide and titanium alloy [as published], their wear resistance has been raised by a factor of up to 10. The surfaces are hardened by embedding nitrogen ions in the crystal lattice structure.

#### **EC Launches BRITE/EURAM Project on Resin Transfer Molding**

93WS0441D *Toddington NEW MATERIALS INTERNATIONAL in English Apr 93 p 5*

[Text] A new research programme in resin transfer, funded under the 1993 round of BRITE/EURAM II, has been awarded. The programme, with a total value of ECU2.96 million, is entitled "Simulation of the Resin Transfer Moulding Process for Efficient Design and Manufacture of Composite Components." The work programme began last December and runs for three years.

The collaborating bodies are British Aerospace Airbus Ltd (UK, project coordinator), Brochier SA (France), Inasco Hellas (Greece), INASMET (Spain), Intracom SA (Greece), Short Brothers (Ulster), Sonaca (Belgium), TNO Plastics and Rubber Research Institute (Netherlands) and University of Plymouth (UK).

The aim of the work is to improve design methods for the RTM process and to advance the state-of-the-art. The first task is to improve the material characterisation and provide input data for Task Two. Task Two is the development of computer process-simulation to predict quasi-three-dimensional flow in a component exhibiting a range of features of increasing complexity as the project proceeds. Task Three will be validation of the predictions against experimental mouldings. Task Four will build an Intelligent Knowledge Based System (IKBS) to guide designers toward the optimum solution.

Potential sponsors of this programme should contact Jan Peeters at TNO Plastics and Rubber Research Institute Schoemakerstraat 97, Postbus 6031, 2600 JA Delft, The Netherlands.

#### **New Metal-Extrusion Process for Metal Alloys**

93WS0446C *Paris L'USINE NOUVELLE/ TECHNOLOGIES in French 15 Apr 93 p 12*

[Article by Michel Vilnat: "Friction Extrusion"; first paragraph is L'USINE NOUVELLE/TECHNOLOGIES lead]

[Text] This new process improves the properties of the finished product and saves power.

The metal extrusion process developed by the Britain's TWI [The Welding Institute] welding institute saves on power and improves the mechanical properties of the finished product. With this system, friction replaces the external heating mechanisms traditionally used to soften the alloy for extrusion.

First, a cylindrical cartridge is filled with the material to be extruded (in powdered or chipped form). A capped piston bored to the shape and diameter of the finished product presses the powder into the cartridge. The cartridge is then made to rotate, while the piston remains stationary. This movement rapidly heats the material to a paste, which melts the cap, initiating extrusion. Pressing and rotation continue until the cartridge is empty. As the material cools, a metal rod is formed.

A variation on the process consists of pressing the powder into a stationary cylinder with two pistons rotating in opposite directions. The extruded metal is evacuated through a hole in the cylinder.

This new technology makes it possible to produce rods made of both alloys and metal matrix composites. The isostatically extruded material has excellent mechanical properties. The first 180° bend tests on an aluminum alloy (6082) obtained with this method showed the metal to have very good ductility.



## Belgium: AMT Company 'Monopoly' on Copper Memory Alloys

BR1205151293 Zellik *TECHNIVISIE* in Dutch  
16 Apr 93 pp 59, 61, 63

[Article by A. Calders: "Memory Alloys, Ready for Application"]

[Excerpts] AMT in Herk-de-Stad is virtually the only company in the world which can make memory alloys. This entirely new material is characterized by some striking properties, including super-elasticity, where the metal behaves like a rubber band; high specific damping, where the metal acquires cardboard-like properties; shape memory, where the material acquires another, preprogrammed shape when a certain temperature, the transformation temperature, is exceeded.

This effect is reversible, and the element regains its "cold" shape as it cools down to below the transformation temperature. The transformation temperature can vary from -100 to +200° C depending on the composition of the alloy. These properties are based on a phase transformation, i.e., a martensitic transformation.

AMT's main industrial competitors for Ni-Ti-based memory alloys are the Japanese firm Furukawa and the former metals division of Raychem in Menlo Park, United States.

For a second range of memory alloys, those based on copper alloys, AMT has a worldwide technological monopoly; initial results in the industrial development stage date from mid-1992. Now, marketing is underway, via a worldwide network of agents. Sales revenues in 1992 amounted to 10 million Belgian francs [Bfr] (the company had three employees). However, during the first two months of 1993, orders worth Bfr30 million had already been booked, and the number of staff had risen to seven. Mr. Van Moorleghem [AMT founder] hopes to top Bfr200 million within two years. He also intends to transform the company from a memory alloy engineering firm into a supplier of materials which also provides product development support. In the coming years, memory alloys will make a breakthrough in a series of applications which have so far been impossible.

### Long Road to Marketable Materials

[passage omitted] Developments moved slowly, and in 1986 the product [memory alloys] was transferred [from the university of Leuven] to a company called Proteus NV. In 1989 the technical director of Proteus, Wilfried Van Moorleghem, bought the know-how and patents of Proteus and started up AMT (Advanced Materials and Technology). AMT, which markets small applications for the aerospace and other industries, wanted to perfect the industrial production of copper memory alloys in both tape and wire format. This was done in collaboration with the Metallurgy and Applied Metallurgy departments of the Catholic University of Leuven. In 1990, a new partner, Swissmetal, joined the other two. Some

subsidiaries of this group (casting, extrusion, hot rolling at Dormach Metalworks and hot wire drawing in Boillat) are now producing the base material. This operation is supervised and monitored from Herk-de-Stad, which also handles the marketing and development activities of both the memory alloys and products. In August 1992, the point was reached where CuZnAl memory alloys could be manufactured on an industrial scale, with delivery periods of three months.

In November 1992, AMT took over the Ni-Ti-based memory alloy activities (know-how, patents, shares, customers, etc.) of the German Krupp company. This was made possible by the participation of the GIMV [Regional Investment Company for Flanders] in AMT's capital. AMT is now also able to produce Ni-Ti memory alloys.

The CuAlNi alloys have almost reached the production stage, and work is already under way on CuZr- and Fe-based molded memory alloys. The advantage of all these different memory alloys is that they have complementary properties, so their applications enhance, rather than compete with, each other. [passage omitted]

### From Experiments to Products

As a result of the "miraculous" potential applications of memory alloys, there has been industrial interest right from the start. However, since there were no cost-effective processes to produce the material, no major contracts could be concluded. The production costs of the experimental materials were extremely high and the delivery times often too long. Consequently, actual applications—submitted as spontaneous requests to AMT—were mostly found in special fields, such as the aerospace industry. The materials requirements of this sector were almost certain to direct attention toward memory alloys, because they can develop maximum strength using a minimum amount of material, and they can do so in a controlled, physically reliable way (as the temperature increases, a material transformation always occurs, whereas turning on an aircraft engine for the first time after years of flying provides no guarantee that it will run).

AMT is now ready to round off the experimental phase and start marketing a series of new products. In most cases, the materials will be adapted to customer applications. Some "products" which have already been requested for various applications, such as the linear SMA (Naval and Air Signaling Company) actuator and certain types of memory metals, will be included in the production range.

The production process has been finalized and uses an adapted casting procedure and special hot rolling and hot ultrasonic wire drawing machines. The memory alloys can now be supplied in industrial quantities, and sales representatives are already operating in France, Germany, Singapore, Malaysia, Indonesia, Israel, Switzerland, and the United Kingdom. This should result in

a rapid increase in sales revenues to several hundred million Belgian francs. AMT's expansion into an industrial company has begun.

## AEROSPACE

### Germany: Call to Halt Decline in Aircraft Engine Market

93WS0391A Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 8 Mar 93 p 10

[Article by Helmut Huff: "German Industry Must Struggle to Keep Its Share of the World's Aircraft Engine Market: Developments in Materials in Recent Years Have Brought an Enormous Surge in Innovations/Key Technology Materials (14)."]

[Text] Frankfurt—Most civil and military aircraft are powered by gas turbines. The engines generally account for about one quarter of the cost of the aircraft, and engines plus fuel together make up about half of the aircraft's weight. The overriding goals of aviation—fuel conservation, weight reduction and lower cost—are thus of particular importance. Additional forceful impetus results from the eclipsing demand for high reliability and low pollution emissions.

Fuel consumption by aircraft gas turbines has been lowered in the last 30 years by 30 percent, and the thrust-weight ratio has been increased by two and a half. Materials technology made a decisive contribution to this. The first major progress was accomplished by the introduction of new materials.

In the 1950's, the nickel alloys surpassed the high-temperature steels in the hot part of the turbine. Nickel alloys allowed for an increase in the gas temperatures and thereby contributed substantially to the decrease in fuel consumption. In the 1960's, titanium alloys with approximately the same strength but with half the specific weight of the steels pushed this by two thirds up to the range of about 400°C and thereby contributed substantially to weight reduction.

The contributions of the primary materials, nickel and titanium alloys as well as steel, have also not changed substantially in the last 20 years. But it has still been possible to increase their utilization. This increase was the work of a multitude of metallurgists, materials mechanics and process engineers: through coordinated use of alloy technology and heat treatment, the strength potential was still able to be increased substantially by about 50 percent.

Workers in casting and forging have learned to handle the very strong materials. Materials mechanics have expanded utilization by applying knowledge of behavior under complex operating conditions and knowledge of

failure effects. The potential of future materials techniques applies basically to fiber reinforced plastics and fiber reinforced metals as well as intermetallic alloys and ceramic materials.

The question is how quickly the new techniques will be ready for use and what contribution they will make. One forecast is that the metallic compact materials will also dominate in the coming decades. Fiber reinforced plastics already hold their place in the range of up to about 200°C. Ceramic materials and fiber reinforced metals will not make a large contribution but will maintain a secure place.

Once metallic materials have reached a high level of development, progress will be characterized by many small steps. Optimization of materials (for example, in lessening creep and fatigue) requires profound knowledge of mechanical materials behavior and metallurgy, so that cooperation among research, materials production and materials application takes on increasing importance.

In addition, the interconnection among the design of building components, methods of production and characteristics continues to grow with the new technologies. Accordingly, process technologists and materials scientists must work together from the outset with the technical designers. This sounds reasonable for everyone, but experience shows that in practice it is a time-consuming process, especially since producers of basic materials, producers of intermediate products and workers on finished products belong to different branches of industry.

German industry must make an all-out effort to maintain its small share of the aircraft engine market. Compared with other nations, the level of technology in the German engine and production industry is high. About one quarter of the motor discs and blades used in Germany are produced by Germany. Nevertheless, there is a marked difference in comparison to the United States. A few facts should prove this:

- Smaller developmental capacity leads to longer introductory times for new components and to a greater expenditure of time in solving problems.
- Serial use of German single-crystal blades has just begun, more than five years later than in the United States.
- Powder metallurgical discs from German forgers went into series, but using powder from the United States (German powder production will, however, soon be authorized).
- In some points, leading foreign producers have a further developed smelting technology than do the Germans.

It can also certainly be established that the German engine market alone cannot make full use of the specific capacities of German forges and foundries.

One outlook for the future is based on the forecast, which must be taken seriously, that the fleet of aircraft will double in the next 10 to 20 years. German industry will have to participate in this, even just to maintain its high level of technology. This challenge will lead to success under the following conditions:

1. Germany's own technological development must be increased significantly. The common (and somewhat successful) practice of climbing aboard the developments of others cannot suffice in the long run, especially as even the take-over of high-level technology requires expertise.
2. Technological development requires federal support. Means of support have recently dropped off drastically in Germany; in the United States, means of support (in consideration of military development) have climbed, especially in the area of materials.
3. The cost-to-performance ratio must be improved. It is surely possible to lower costs of production without limiting usefulness and reliability. Expenditures for development should indeed be invested here first. German industry cannot afford to stand idly by and observe the efforts of American industry.
4. Since the German engine industry alone cannot make full use of ancillary German businesses, these must open up additional markets for high technology products. New technologies must (more than before) be developed in joint programs of users and producers.

The outstanding qualifications of scientific and engineering potential in our country encourage confidence. Our future in high technology cannot be allowed to founder because of a lack of foresight. The engine construction industry has always been a pioneer in applied materials technology.

*The author of this article, Dr. Ing. Helmut Huff, is Director of Materials Technology of the MTU Motor and Turbine Union Munich GmbH in Munich.*

### **German-Russian Cooperation in Space Projects**

93WS0391B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 10 Mar 93 p 8

[Unattributed article: "Germany and Russia Cooperate: Cooperation on Space Craft Projects; Waste Disposal With Rockets?"]

[Text] Frankfurt—To further enhance the cooperation already evident in some projects, the directors of the German and Russian space agencies have agreed on additional steps for joint research and the use of space. Among these are the Express capsule for experiments with weightlessness in earth orbits, an electronic multi-spectral camera for earth research done by the Mir Station, and the two photographic systems for the Mars space probe which is to be launched in 1994.

It is not certain at this time whether the originally planned second joint flight by a German astronaut to the Russian station Mir can be financed. The General Director of the Russian space agency, Yuri Koptchev, is hoping for joint European-Russian cooperation in the development of a new space craft to replace the canceled Hermes Glider. In 10 years at the latest, Russia should have developed a new rocket and a more productive manned space craft.

Koptchev even thinks Russian collaboration in the planned international space station Freedom is possible. Conversely, the Mir station could even serve as an alternative to the future manned space flight in case the Freedom project and the European Columbus module along with it cannot be completed because of insufficient financing opportunities.

The Russian Buran space glider, however, will no longer be launched in coming years. But using the large Energiya rocket with its 100 tonne carrying capacity for low earth orbit for the disposal of radioactive waste on the sun or in outer planetary systems, as Koptchev proposed, is ruled out, not only because of the enormous danger to the environment in the case of a possible mis-launch.

### **Deutsche Aerospace Assesses Airliner Demand for Next 20 Years**

93WS0425A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 18 Mar 93 p 8

[Text]

**International Demand Approximately 16,800 Commercial Aircraft**

### **DASA Anticipates a Market Volume of \$835 Billion By the Year 2012**

Deutsche Aerospace AG (DASA) anticipates a world market demand of 16,800 commercial aircraft with a market value of \$835 billion over the next 20 years. For the period up to the year 2012, the Daimler-Benz subsidiary assumes an average growth rate of 4.9 percent per year for jets with over 70 seats. The growth in regional transport will be an even higher 6.4 percent. At present there are about 13,100 commercial aircraft in use worldwide.

According to the DASA study, the demand figure is divided into 10,800 jets with over 70 seats, valued at about \$780 billion, and 6000 commuter aircraft (regional shuttles), which represent a market value of about \$55 billion.

In 1992, according to DASA information, the world's aircraft manufacturers delivered a total of 776 jets, 157 of which came from the Airbus consortium in which DASA has almost a 38 percent share. Aircraft orders worldwide amounted to only 476 machines. Of these, 136 went to the Airbus consortium.

The delivery figures, after dropping to about 600 jets per year until the end of the decade, will then rise again somewhat above this number. Altogether, the average delivery number for the above-mentioned 20-year period would be about 540 machines. Deliveries of commuter aircraft should be about 400 planes per year until the end of the forecast period.

International economic growth and the development of fuel prices could force down the demand for aircraft by three percent or else drive it up by two percent. The increasing use of high-speed trains could, in the long run, threaten the delivery of up to 200 aircraft with over 100 seats. In the CIS [Commonwealth of Independent States] countries, air traffic should first decline before rising again after 2000; by 2012, the demand should reach a total of 1500 machines.

#### **Germany: D2 Spacelab Mission Biotechnology Experiments**

93WS0425B Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 23 Mar 93 p 8

[Text]

#### **Applications-Oriented Experiments in the Forefront for Spacelab Mission D2**

##### **94 Scientific Experiments on Board**

##### **Techniques and Procedures to be Tested for Columbus**

Thus far, the American space shuttle has flown its most technically successful and scientifically profitable missions with Spacelab, built primarily in Germany. Since 1983 there have been almost a dozen such orbiting missions with significant German involvement. Meanwhile, the Americans have also undertaken several spacelab flights in which they have profited from German and European groundwork.

The D2 mission primarily serves the Columbus space station, planned for the end of this decade, as well as initial tests of technical and operational procedures for running manned long-term orbital laboratories. An additional goal of the present spacelab mission is to secure Germany's leading role in zero-gravity research and manned space flight experience.

The plan is to put Spacelab into a nearly 300-kilometer-high orbit with an inclination of 28.5 degrees with respect to the equator and a 90 minute orbiting time. Five hours after launch, the space laboratory will begin operation and will then be manned round the clock for about 210 hours by two groups of astronauts. The length of the flight is estimated to be nine days. It may be increased by one day. This time, the emphasis of the scientific research program has been shifted more to applications-oriented experiments, for example crystal growing and human medicine. The scientists anticipate, among other things, that new discoveries will be made in

growing gallium arsenide crystals. That could lead to better semiconductor materials for the computer industry.

In the human medicine projects, research will be done on the effects of weightlessness on the human body. This could yield information on new diagnostic and treatment methods for certain diseases on earth. "Success in the production of new enzymes and proteins could perhaps be used one day in the manufacture of new drugs with improved properties," explains Ulrich Walter, one of the two German astronauts.

For mission management, the DLR in Oberpfaffenhofen expanded its GSOC control center. Here the scientists will monitor their experiments during the flight and discuss variations in the experiments with the astronauts. The widespread scientific impact of such a spacelab mission can be seen in the astonishing number of over 200 proposed experiments and the large number of participating researchers and institutions in Germany alone.

Twenty-seven universities with 36 institutes, three national laboratories (DLR, Fraunhofer Society, and Max Planck Society), and nine German industrial firms are taking part in the D2 experiments. There are also experts from 22 foreign university institutes in European countries, Japan, and the United States. In addition, six companies from these partner countries are involved with research projects and technical support.

The American space agency, NASA, is providing biological and human physiological equipment, the French CNES, a melting furnace for testing materials, and Japan's NASDA, additional materials science experiments.

The D2 payload consists of research equipment for a total of 94 scientific experiments with a combined weight of almost 3700 kilograms. The individual devices are grouped together in the instrument racks according to themes. The most important of these are:

*Medea* for processing metal and composite materials, for studying diffusion processes, and for melting silicon crystals as well as carrying out critical point studies in fluids.

*Biolab* for studying living material with electrocell fusion and cell cultivation for zoological and botanical experiments on gravitational biology in earth orbit.

*Holop* for optical studies in transparent media with contactless measuring methods to investigate convection and diffusion processes in zero-gravity.

*Materials Laboratory* for materials science experiments in the areas of metallurgy, glass/ceramics, crystal growing, and fluid physics.

*Anthro-Rack* (from the ESA [European Space Agency]) for human physiological studies, especially cardiovascular function in zero-gravity as well as metabolic processes and hormone production in man.

*Baroflex* for human medicine experiments, especially for investigating blood pressure regulation in zero-gravity.

*Rotex* is a small robot in the space lab with six degrees of freedom which carries out a small experiment automatically. There are also some experiments on a platform mounted outside the cabin in the shuttle cargo bay.

*Moms* is an electronic stereocamera system for scanning the earth surface in several spectral regions simultaneously.

*Gauss Camera* for celestial photos of the Milky Way in ultraviolet light with a superwide-angle objective system.

*Aoet* investigates the influence of atomic oxygen on test materials.

*Radiation Detectors* measure cosmic particle and solar ultraviolet radiation.

The cost for D2 comes to a total of 890 million German marks [DM], spread over the years from 1987 to 1995. Included in this figure are DM250 million for NASA's launch services as well as DM180 million for DLR's technical-scientific organization. Development of the experiments has consumed the largest share, DM330 million. There is another DM130 million for payload integration. On the other hand, about DM130 million flow back into Germany from the participating countries—America, Japan and France—as well as from the ESA.

#### Germany: D2 Spacelab Missions Delay Reported

93WS0425C Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 24 Mar 93 p 8

[Text] After yesterday's failure, the launch of the second German Spacelab Mission (D2) will be postponed for "at least three weeks." The German Aerospace Research Institute (DLR) at Germany's mission control center in Oberpfaffenhofen near Munich made the announcement. Experts at American space flight center Cape Canaveral are now busy with troubleshooting and additional safety measures on the space shuttle Columbia.

According to preliminary analyses, a valve in one of the three main engines of the space shuttle failed, causing the computer to interrupt the launch sequence. There may also have been an instrument defect. Whether or not the space shuttle, still positioned vertically, can remain on the launch platform will depend on the error analysis. On Tuesday, the large tank will be emptied and this Wednesday, the engines will be examined.

There will certainly be an inspection and replacement of some tests and research equipment in the Spacelab science laboratory in the space shuttle's cargo hold, said the DLR spokesman. Above all, the biological tests must be replaced. The spokesman mentioned considerable additional costs caused by the launch postponement which could amount to 1 million German marks [DM]

per week. The D2 mission, originally scheduled to launch on February 25 and delayed several times, has cost DM890 million so far.

#### Germany: RITA Ion Thruster Available for Commercial Application

93WS0426A Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 25 Mar 93 p 8

[Article by re: "The Ion Thruster Rita is now Commercially Available"]

[Text]

#### Deutsche Aerospace is Working with High-frequency Field and a New Ignition System/Application on Artemis

RITA, the ion thruster, was developed to stabilize the position of communications satellites. It is now ready for commercial applications, reports Deutsche Aerospace. RITA is an acronym for radio-frequency ion thruster assembly. At this time, RITA is one of 15 experiments operating on the platform of the German research satellite Eureka. The platform is 2.5 by 4 meters in size. At the same time, ground-based tests are being performed. At the end of July 1992, Eureka was put into earth orbit. It is to be brought back to earth again on the space shuttle Atlantis this coming April, according to the schedule.

After its suitability has been proven, RITA is to be used to stabilize the position of the experimental communications satellite Artemus in addition to an English comparison thruster. Artemus is to remain in orbit for 10 years. During this time, its position must be corrected twice daily. For Artemus, the ion thruster was simplified again and its power increased from 10 to 15 millinewtons. During the 10-year test, RITA will use only 30 kilograms of xenon as fuel. This type of ion thruster, having a power of 200 millinewtons, is already in the planning stages for a Mars mission.

RITA differs in a few very important points from previously developed ion thrusters, reports the company in its internal newspaper "New-tech News" (1/1993). A high-frequency field of about 1 Megahertz is being used to accelerate all electrons located in the discharge chamber so that they produce a plasma by colliding with neutral gas particles. In this process, the ion density can be easily regulated by the magnitude of the supplied high-frequency energy. The ion density determines the magnitude of the thrust finally.

A new type of thruster ignition system is being combined with the improved form of ionization, it further reported. No longer does an energy-intensive arc at the gas inlet produce the ions and free electrons. Rather, the electrons are supplied by a neutralizing cathode and then pulled into the interior of the discharge unit by a positive 1.5 kilovolt voltage. Here, they are caught and accelerated by the high-frequency field.



An electrical voltage then ejects the produced ions through a grid. These ions provide for the desired reaction force in this manner. The electrical structure of this grid plays a decisive role according to claims by Deutsche Aerospace. This grid is responsible for focusing and directing the exiting gas beam.

For this purpose, a special control electronics system is being used. Among other tasks, this system only applies the high voltage to produce the electrical fields for focusing and acceleration when thrust is required from the thruster. In the remaining time, the high-frequency field is kept in a standby mode.

#### **Germany: Advanced Flight Simulator in Operation at Berlin University**

*MI1105121993 Berlin FORSCHUNG AKTUELL  
in German Mar 93 p 3*

[Text] An ultramodern flight simulator, the Airbus A-340 simulator, will go into operation at Berlin Technical University in April 1993. The simulator is a faithful replication of the cockpit of the latest civilian airliner developed by the European Airbus Industry consortium. The Airbus A-340 is a four-jet long-haul airliner capable of carrying up to 260 passengers over distances up to 13,000 kilometers. Lufthansa took delivery of the first aircraft of this type at the beginning of February 1993, and it entered scheduled service on the Newark run on 15 March 1993.

The Airbus A-340 flight simulator provides realistic simulation during the flight run of all the operations performed in the cockpit. Critical and abnormal situations and emergency procedures, such as those carried out in the event of engine fire, smoke caused by cabin fire, or system failure, can be replicated repeatedly and without danger in the flight simulator, thus preparing the trainee pilots for all flight contingencies.

The flight simulator also comprises a vision simulation system for added realism, thus guaranteeing a faithful replication of the ground view from the cockpit, particularly of the runway used during approach and landing. The full range of meteorological conditions, from broad daylight and clear visibility to fog and darkness, can be simulated. Around 40 different airports are currently stored in the system, so the approaches to Frankfurt, Berlin, Hong Kong, and other cities can be practiced one after another. At the same time, a motion simulation system keeps the 13-tonne imitation cockpit in constant motion, regardless of flight status, giving the pilots in the simulator the sensation of actual flight.

Research and development programs involving the A-340 flight simulation cover topics including data display and recording sequences and the working procedures of pilots in highly-automated cockpits such as those of the Airbus and similar existing and future aircraft. A central area of research is the man-machine interface, with

reference to all areas relevant to flight safety. The simulator is also eminently suited to testing new electronic and aircraft control systems.

The flight simulator is operated by the Berlin Flight Simulation Center [ZFB] at Berlin Technical University, an associate company of Lufthansa, which holds a 50-percent stake, the other 50 percent being shared equally between German Aerospace Airbus, the German Aerospace Research Institute, and CAE Electronics, the Montreal-based manufacturer of the simulator. The project has received financial support from both the Berlin Senate's Industry and Technology Administration and the federal government.

The ZFB is located at Berlin Technical University, with which it has a cooperation agreement whereby the university, and particularly the various departments of its Aerospace Institute can use the simulator for teaching purposes and for research projects financed by third parties.

However, the ZFB's primary purpose is to make the opportunities offered by a modern simulator such as the Airbus A-340 simulator available for research and development work. To this end, the simulator has a specially developed hardware and software expansion unique the world over in the scope it provides for simulation research.

#### **Italy: ASI Director on San Marco Scout Carrier**

*MI0206142093 Rome SPAZIO INFORMAZIONI  
SPAZIO ITALIA Supplement in Italian Mar 93 pp 5-6*

[Interview with Professor Carlo Buongiorno by SPAZIO INFORMAZIONI: "The San Marco Scout, You Think About It"]

[Text]

[SPAZIO ITALIA] Why did the Italian Space Agency decide to equip itself with a carrier for launching small satellites in its National Space Plan for 1990-94?

[Buongiorno] It is strategic for a country like Italy, which has great ambitions for the development of its space activities, both in the scientific and in the technical-industrial field, to be able to plan for a carrier for the launching of small satellites. Japan, for example, thought from the start that it should have its own autonomous launching capacity in order to carry out a real space program. Europe, pushed by France, has also reached the same conclusion with the Ariane launcher program. Furthermore, such an initiative makes various activities possible at a national level and can also reflect on future commercialization.

It is, however, clear that the availability of a small launcher is of no significance if there is no launch site. La Sapienza University in Rome has constructed a site in Kenya for the San Marco Project and has trained the

launching personnel. At the end of the 1970's, La Sapienza proposed the construction of the San Marco Scout, a new launcher designed by Prof. Luigi Broglio by making various improvements to the well-known United States Scout launcher.

The ASI [Italian Space Agency] entertained this idea both because in the parliamentary agenda for the institution of the agency there is a recommendation from parliament to this effect, and also because we believe in it. Obviously, it was our objective that this project should not be limited to a mere importation of materials and components from the United States, but also that the San Marco Scout should progressively become an Italian product that could be developed in the future. The National Space Plan foresees the realization of two parallel programs. One being the university program for the development of the first carrier prototype and the other being for the industrialization of the project and for the successive study of new families of launchers based on this experience. This latter program, entrusted to BPD Difesa e Spazio (Editor's note: for a global contract value of more than 120 billion lire) is already under way. Meanwhile relations with La Sapienza University have met with some surprises.

**[SPAZIO ITALIA]** As a matter of fact, after a long delay in the funding, the magistrate's court in Rome ordered the ASI to complete the 90 billion lire payment for the University of Rome program a few weeks ago. But what has happened?

**[Buongiorno]** The accord between the ASI and La Sapienza had been signed and our board of directors had therefore agreed upon the payment of the first 30 billion lire. However, external factors, some of which derived from the governing authorities, then suggested that we should stop. There was some news that essentially regarded the effective willingness of the company constructing the Scout, the U.S. company LTV/Loral, to supply the necessary carrier for the construction of the first prototype of the new San Marco Scout. The ASI board of directors, therefore, only paid the first 5 billion lire. But, after the court verdict in Rome, we paid the first installment of 42.5 billion lire in mid-February. This will shortly be followed by the second installment of the same value. It certainly has not been a spontaneous payment and the Attorney General has advised us to state this clearly. In fact, as of today, we have no evidence that the San Marco Scout program, as it was originally proposed by the University of Rome, is still feasible. The discussion is still open. Perhaps, however, the conflict between the ASI and the university that even led to the "carrier in court," could have been avoided.

**[SPAZIO ITALIA]** Hasn't the ASI tried to clarify the situation and to reassemble the pieces of this conflict?

**[Buongiorno]** If they had sat down round the table like reasonable people and faced the problem, the situation would probably have been clarified. But they did not do this and things were negatively influenced by external

factors. In this way we are only benefitting those outside our country who do not want Italy to continue with this ambitious initiative. I am seriously worried and I am not sure if, by following this road, we can really develop a national carrier. We must reestablish harmony between the ASI and the University of Rome. The university has some of the equipment and the fundamental experience required to develop this project, including the site in Kenya. It is important for both of us to study how the entire San Marco Scout program can be redirected to take it back to a state of effective feasibility. On the other hand, I do not think that today we can consider constructing a small launcher without the involvement of the University of Rome.

**[SPAZIO ITALIA]** What do you think about the problems regarding the purchase of the basic Scout carrier from LTV/Loral?

**[Buongiorno]** When constructing a carrier the most logical step is starting, if possible, from a consolidated object that has been well tested. But if this is completely lacking, then obviously it is necessary to think about something else. I am sure that if we go more deeply into talks with LTV/Loral, something positive could come out. It is, however, important that the characteristics of the system to be developed as a prototype, this being a sort of "meccano" construction, correspond to what we are constructing at an industrial level. The two programs must remain linked. In any case, without a sound program and precise development schedules, I think that the project for this carrier will be in difficulty. I am sure, however, that today we still have all the elements for carrying it through.

**[SPAZIO ITALIA]** What is the status of the BPD program for the industrialization of the San Marco Scout? Is there any news?

**[Buongiorno]** The industrial program is still logical because the systems we are developing are those that will remain in any case. These being the solid propellant boosters and the components for the guiding system. When the first uncertainties arose about the availability of the basic Scout carrier, we started to imagine another configuration that would be a little different from the original. With this new configuration the second and the third stages of the original Scout would be replaced by a single national stage, the IRIS [Italian Research Interim Stage] engine would be used as a final stage, and with the adoption of thicker heat shields. Such a configuration, therefore, would be based on all the technologies currently available in Italy and would depend on how much systems know-how LTV/Loral could make available to us. At the same time it would be necessary to use the expertise of the University of Rome which plays a central role in the launcher and has enormous resources of knowledge.



**Italy: San Marco Scout Project Director  
Interviewed**

*MI0206141593 Rome SPAZIO INFORMAZIONI  
SPAZIO ITALIA Supplement in Italian Mar 93 pp 7-9*

[Interview with Professor Luigi Broglio by SPAZIO  
INFORMAZIONI: "The Professor's Scout"]

[Text]

**[SPAZIO ITALIA]** The recent funding of 42.5 billion lire to the University of Rome by the ASI [Italian Space Agency] has effectively started the development program of the first prototype of the San Marco Scout carrier. This was your idea and was proposed in the 1970's. What activities are you planning now?

**[Broglio]** As far as the development of the San Marco Scout is concerned, the first thing to be done is to complete the study of the new elements. This work mainly comprises wind tunnel tests relating both to aerodynamic characteristics and stability and the separation mechanisms of the boosters. This first stage will take about six months. Once this data has been obtained and any modifications have been evaluated, we can pass to the construction project. Finally, we must construct the additional parts. These are essentially the separation system of the four Algol-3 rockets from the central one, the aerodynamic cones of the same four Algol-3 rockets, and any modifications to certain circuits of the guidance and control systems.

**[SPAZIO ITALIA]** Worrying reports are coming from various sources about the effective availability in the United States of the Scout and the necessary Algol rockets. What can you tell us about this?

**[Broglio]** LTV/Loral in the United States has actually done some research to check whether the various components of the Scout are available on the market. Following this research the company concluded that it was willing to collaborate and to supply a complete Scout-G1 carrier and four Algol-3 motors to boost the first stage. Therefore the willingness of the American company seems clear to me. LTV/Loral, in fact, have taken into consideration the fact that the United States Air Force is launching the last two Scouts and that the spare parts being held in storage for these two launches could later be ceded by NASA to the company at a very low price. It is also true, however, that these spare parts may not become available if, for example, some United States government body intended to have another Scout constructed using these unused spare parts. But, if this should happen, LTV/Loral would have to construct another Scout in addition to the one requested by us, and it would therefore be reasonable to think that the non-recurring costs, which are very high, would then be divided between the two customers.

**[SPAZIO ITALIA]** What does the San Marco Scout mean for Italian space activities?

**[Broglio]** The San Marco Scout is primarily a means of obtaining information about launcher technology. It will be the maximum possible allowed to us within the constraints laid down by the United States government. Therefore the money that we have to pay to LTV/Loral is being spent for the purpose of obtaining sufficient information about a system that could then be developed in Italy. This is an R&D program. The project for the new carrier was initially studied by us and therefore is our property. On the other hand, in this specific sector our industries are not very advanced. It is important to understand that it is time-consuming to start from zero and develop a program from scratch, even if you use known and proven elements. Consider the United States carrier Pegasus. Three years from the first launch, it is still not really clear if it can be considered efficient. Had we started the program two years ago or even many years ago when it was proposed, these problems, which emerged later precisely because of the delays in funding by the ASI, would not have arisen. However, I think that a large part of the research and development will be done in Italy, and primarily the part regarding the system. Certainly, if we had obtained more funding we would have been able to do more. In this way, however, we are always obliged to choose whoever costs less.

**[SPAZIO ITALIA]** What role will the San Marco site in Kenya play in this context?

**[Broglio]** In fact, I think that the crux of the problem is precisely our site and not the carrier. There are only two launch sites on the equator (these being the Guyana Space Center at Kourou in French Guyana and the San Marco site off the coast of Kenya). If one of these is closed only the other remains and that certainly would not be ours. It is therefore important to maintain our position and keep our site working, as both a means of international cooperation and a source of prestige for our country. We must therefore have the San Marco Scout available as soon as possible and start up new experiments again.

**[SPAZIO ITALIA]** Italian industry, in collaboration with the ASI, is starting to evaluate the construction of a new carrier using primarily national technologies. What do you think about this?

**[Broglio]** To me this would be insane! It is one thing to develop a single propulsor or a guidance system but it is something completely different to construct a complete carrier that works. Experience shows that a great deal of time and money are necessary to perfect a system of that type. Furthermore, such a proposal would be an attempt to destroy our program and our site. The latter would probably remain inactive for many years. Our project, instead, provides for the first launch of the San Marco

Scout between the end of 1995 and the beginning of 1996, perhaps with the international scientific satellite Equator-S on board.

I think that the best thing is to respect the pacts we have signed. In accordance with these pacts, while the University of Rome dedicates itself to the development of the San Marco Scout, industry should start to develop a propulsor to replace the Algol-3. The BPD contract with the ASI, in fact, deals with "the Italianization" of the carrier developed by the university. If, therefore, we proceed with the development of a program in which parts coming from the United States are gradually replaced by parts produced in Italy, our industry could immediately enter into the international scene of the launcher sector and without having to wait many years for the launch of this Italian carrier. And in doing so we will also save the Kenya launch site.

#### **Italy: Development Schedule of San Marco Scout Carrier Outlined**

*MI0206131793 Rome SPAZIO INFORMAZIONI  
SPAZIO ITALIA in Italian Mar 93 pp 10-11*

[Interview with Pier Giorgio Romiti, director of the Space Division of BPD Difesa e Spazio: "Objective: An All-Italian Launcher"]

[Text]

**[SPAZIO ITALIA]** At what stage is the industrialization program of the San Marco Scout carrier?

**[Romiti]** Our program is going ahead according to plan apart from just a few delays. In the meantime we are developing the new elements for the carrier which include the engines for the first stage, that is, the four boosters and the main engine, the guidance system, and the heat shields. We should finish this design stage in April or May and then we will pass to the execution stage, that is to the development.

We should be carrying out the first ignition trials on the engine for the Zefiro first stage at the Perdasdefogu site in Sardinia by next June. In this test we shall be trying out a higher filling level for the solid propellant even though the Zefiro will still not be in its final configuration with the casing larger than in the final version. When this firing test has been carried out we shall have overcome one of the first obstacles. Then we will work on perfecting the engine casing. I do not foresee any great delays. There is clearly some problem between the University of Rome and the ASI [Italian Space Agency]. We are not involved in this issue at all, but could obviously run the risk of suffering some of the consequences.

**[SPAZIO ITALIA]** Can you confirm that BPD, in accordance with the ASI, is evaluating the possibility of modifying the configuration of the carrier proposed by the University of Rome?

**[Romiti]** Precisely. This is our intention and it all started when we were making comparisons with LTV, now Loral, of the United States, who told us: "Be careful! It is certainly a valid idea to work on an old thing, changing and improving it. However, this is clearly not the best." That is, you can optimize the configuration to construct something that is truly valid and will last for another 30 years, not for just two years. We have already prepared this proposal and we will go ahead if the ASI accepts it. Since this idea is based on the same principle as the San Marco Scout, the program remains the same for us.

**[SPAZIO ITALIA]** And the new Sesamo stage?

**[Romiti]** Sesamo effectively lags behind the others because it constitutes a new element that should replace the second and the third stages of the old Scout.

It is here that the optimization of our proposal is revealed. First, the diameter of Sesamo would be the same as the lower stage Zefiro, from which it derives, and then it would replace two stages of the Scout by just one. This has an enormous cost advantage. It also has the technical advantage of giving the launcher a more balanced trim.

**[SPAZIO ITALIA]** How can the studies made by the University of Rome for the development of the San Marco Scout prototype help your industrialization program?

**[Romiti]** I have always taken care of things by myself. I think that if the university program had started when it should have done, perhaps it would have helped us. However, we would have still borne the burden of the risks. If the university program were not to start now we could manage just the same.

One thing is certain: If the University of Rome could start with the modernization of the launch site in Kenya by taking into consideration the new configuration that we are evaluating with the ASI and LTV/Loral, this definitely would be a great advantage.

**[SPAZIO ITALIA]** When could the first mission of the newly-configured launcher take place? And do you think there are customers for small satellite launches?

**[Romiti]** If the ASI gives us the all clear, the first launch is slated for 1996. The costs of developing the program would be approximately the same with a few increases for the new parts perhaps.

If we construct this launcher we will keep the price low and also develop low-cost small satellites. According to our evaluations there are many universities in the world with a few billion lire available for launching their own little satellite. I am convinced that it could really be a success.

## AUTOMOTIVE INDUSTRY

### British Company Produces High-Integrity Squeeze-Cast Pistons

93WS0439P *Toddington NEW MATERIALS INTERNATIONAL in English Feb 93 p 5*

[Text] T&N Technology has developed new techniques for producing squeeze cast pistons—ahead of anticipated demands from the motor industry for high integrity pistons in performance diesel engines.

T&N Technology claims the current squeeze cast method, which uses cast iron Alfin rings (sprayed with plasma for improved bond strength) and fibre reinforcements, is already capable of producing porosity free pistons with high integrity, but new developments at the Cawston House research centre (Rugby) have led to a number of further improvements.

The key to these improvements is a new dense salt material which has been developed by T&N Technology's Ceramics division. The new material—which combines salt with ceramics—has enabled T&N Technology to cast aluminium pistons with integral galleries to allow oil cooling of the piston crown and ring pack.

The new salt-based material can be used for the galleries because it is dense enough to resist the infiltration of aluminium during squeeze casting. Thus, it can be formed into a ring and placed in the die during the process and will remain intact throughout.

The salt ring is removed from the piston using a high pressure water jet which leaves behind a clean, hollow gallery.

T&N Technology has overcome the difficulty of providing support for the salt ring in the middle of the die by putting it on top of a fibre reinforcement block, or preform, which is already inserted into the bottom of the die and infiltrated with the aluminium, in order to increase the strength and integrity of the piston crown.

### Spain: SEAT Inaugurates Advanced Factory

93WS0446A *Paris L'USINE NOUVELLE/ TECHNOLOGIES in French 15 Apr 93 pp 9, 10*

[Article by Michel Vilnat: "The Feats of SEAT's Model Factory"; first paragraph is L'USINE NOUVELLE/ TECHNOLOGIES lead]

[Text] Two 3,800-metric-ton transfer presses, a state-of-the-art body shop, use of water-based paints—SEAT is laying on the innovations for its new Ibiza.

The Spanish auto maker SEAT unveiled its new Ibiza a few weeks ago. The only thing that has not changed with respect to the old model is the name. If the product is different, so are the production methods. These choices led to the construction of an ultramodern plant at Martorell, 30 kilometers south of Barcelona. At normal

operating speed, the new industrial complex, which has a covered area of over 400,000 m<sup>2</sup>, will turn out 1,500 vehicles a day, or one Ibiza every 53 seconds!

In order to achieve the highest possible quality and productivity, Martorell's engineers (in collaboration with their colleagues at Volkswagen, the parent company) opted for state-of-the-art solutions, beginning in the stamping shop, where 28 different parts will be made (fenders, hoods, roofs, etc.) using two 3,800-metric-ton Schuler transfer presses. These presses can accommodate up to six dies, depending on the part being stamped. Each time the press is activated, the blanks move forward one step. This machine architecture offers several advantages. A production change-over takes only 10 minutes and does not require human intervention. In addition, the side-by-side placement of the dies made it possible to enclose the machines completely, which means they are particularly quiet (between 70 dB and 80 dB).

Another strong point of the Martorell plant is its body shop, where some 300 Volkswagen-made robots, distributed among several cells, weld the various parts of the body. To guarantee the quality of all the weld points, each gripper is equipped with a hydraulic tightening device which is pressure-adjusted in real time according to the intensity of the current between the two electrodes. This means that the welding parameters remain constant regardless of sheet thickness and electrode wear (up to the replacement limit of the electrodes). In order to ensure uniform production, 15 bodies are culled for full dimensional inspection each day. This inspection is done using a DEA [Digital Electronic Automation] Bravo machine, which automatically records 500 points in 20 minutes with a precision of 0.005 mm. However, the most modern installation is unquestionably the paint shop. The Spanish auto maker now uses water-based paint throughout, for both the primer and the final coat. Paint pigment and adhesives, kept in solution by water instead of the traditional solvents, are deposited by electrostatic atomization. This operation is automated for all easily accessible parts; finishing is done with a gun by a professional. The body is then baked in a drying tunnel, first with infrared and then with hot air. The vapor produced by the oven is essentially steam. The small amount of solvent still necessary (15 percent) is incinerated in a special oven, which eliminates 90 percent of it. "Our two big smoke stacks emit only practically pure steam," the plant manager explains proudly.

A special effort was also made to improve ergonomics. From the weld shop on, the bodies are held by "octopuses" with autonomously powered telescopic arms. There are two advantages to this arrangement. In the event of a problem, a body can be diverted or pulled without having to stop the production line. In the prep shop, the body can be rotated 135°, which makes it easier to reach the underside in order to apply rust-proofing. The Spanish auto maker did not skimp to build its new model. It has invested over 10 billion French francs in this plant, which will employ 6,000 people.

### France: Transputer-Based Real-Time 'Copilot' System Developed

BR1905094793 Paris *ELECTRONIQUE INTERNATIONAL* HEBDO in French 29 Apr 93 p 30

[Article by Pierrick Arlot: "Car Industry: Transputer Enhances Real-Time Navigation Systems"]

[Text] Grenoble—The Aptor Company has been striving to integrate an automobile electronic "copilot" able to do real-time computations of the best route between two given locations. Production could start in 1996.

The development of a car navigation system by the French company Aptor with the support of the PSA [Peugeot]-Renault economic interest group (GIE) has been making steady progress. The electronic copilot, which formerly consisted of an ISA [Industry Standard Architecture]-bus PC board based on three transputers, has now been integrated on a 91x96-millimeter PC/104 board into which are plugged three TRAM modules (Transputer plus 4 Mb of random-access memory [RAM]). (Originally developed by the American company Ampro and currently promoted by a consortium of manufacturers, the PC/104 format has become a de facto standard for on-board systems.) Used in conjunction with an Ampro CPU [Central Processing Unit] board—it was Ampro which pioneered the PC/104 format—the transputer miniboard works like an ultra-high-speed coprocessor: In 95 percent of cases, it calculates the best route between two given points (shortest route in terms of distance, fastest route, or route with the fewer intersections) in under one millisecond....

### As Part of the Prometheus Program

In 1990, fortified by its participation in the European Supernode I and II projects for the development of transputer-based computers, PSA asked Aptor to assess the potential of the Inmos processor [transputer] for on-board computer systems. Soon an application was found: In a car navigation system, the transputer could be used as a mathematical coprocessor in combination with a host computer dedicated to handle screen, keyboard, memory, and input and output management. The project then grew as part of Prometheus, a European EUREKA (innovative technologies development program) project whose overall goal is to increase car and road safety through the use of computers and electronics. A model in the PC/104 format using a PSA-provided cartographic database (a 12x15-km geographical map with 25,000 streets and 16,000 intersections) is now operational. Once the destination and the criterion for best-route selection have been chosen, the system displays each intersection on-screen, indicating the direction the driver must follow. The map is readjusted each time according to data on vehicle position provided by odometer-type sensors (or, ultimately, by Global Positioning Systems [GPS]).

The integration phase is now underway. Aptor will combine all functions on a single board which will be

installed behind the screen. This board should also integrate screen management circuits; a VAN [value-added network] interface; the automobile local area network, developed by the PSA-Renault pool under the aegis of the EUREKA program, to which the position sensors may be connected; and a PCMCIA [PC Memory Card International Association] interface. Changing the geographical map will then only be a matter of replacing the PCMCIA memory card.... According to Aptor, the PCMCIA card's superior sturdiness makes it better suited than CD-ROM [compact disk-read only memory] for this type of applications.

The production phase for such systems, which should cost about 10,000 French francs, could start as soon as 1996. The first market being targeted is that of commercial vehicles.

## BIOTECHNOLOGY

### Germany: Monoclonal Antibodies Used in Rheumatoid Arthritis Testing

93WS0424B Duesseldorf *VDI NACHRICHTEN* in German 19 Mar 93 p 19

[Article by Dieter Schwab: "University of Erlangen Scientists Testing Monoclonal Antibodies; Rheumatoid Arthritis Is Probably an Autoimmune Disease; Rejection of Substances Occurring Naturally in Body Is Neutralized"—first paragraph is *VDI NACHRICHTEN* introduction]

[Text] About 4 percent of all Germans suffer from rheumatoid arthritis. These arthritis patients can now look forward to a new therapeutic approach: The part of the human immune system, which with inflammatory forms of this disease presumably attacks the inner membranes of the joints and the cartilaginous material, can be paralyzed with monoclonal antibodies.

The scientists of a Max-Planck research team headed by Prof. Frank Emmrich, and working on rheumatology at the University of Erlangen-Nuremberg, conclude on the basis of this that what is involved with rheumatoid arthritis, a painful and progressive inflammation of the joints, is a so-called autoimmune disease. Emmrich says that with illnesses of this type the immune system attacks the body's own organs because it mistakes their tissue structures for foreign substances like, for example, disease-causing agents. Taken collectively, these are referred to as antigens, and the immune system as a rule combats them accurately with quite specific antibodies which are "matched" with their respective antigens.

But evidently these antibodies that are aimed at their body's own structures get into the bloodstream again and again from the thymus, where these defense cells are produced. In a normal situation this does not pose any particular problems since, so to speak, "individual instances" are involved. But an autoimmune disease may be triggered if these defense cells run into bacteria,



viruses, or fungi that are similar to body structures. Since, when that happens, the immune system is activated. These antibodies, which recognize errors—and are, so to speak, perverted to become antigens—now suddenly multiply and spread on a massive scale into other parts of the body as well, in the case of rheumatoid arthritis, specifically into the joints. As a result, a painful inflammation of the inner membranes of the joints and the adjacent cartilage begins to be apparent, in the fingers first.

Accordingly, the first signs of the incipient condition are swelling of the joints, which finally leads to their destruction and deformation. About 4 percent of all Germans are afflicted with this disease. Women are two to three times more likely than men. Rheumatoid arthritis annually results in expenditures amounting to about DM8 billion produced by medical care, loss of working hours, and early pensioning for the person affected with the disease. The mostly very slowly progressing disease process can at best be alleviated, but not cured.

The team headed by Emmrich has now been trying to deliberately eliminate the so-called helper-T lymphocytes of the human immune system. This special type of white blood corpuscle "recognizes" structures foreign to the body and then, via a complicated regulating mechanism, activates so-called killer cells which are supposed to destroy the "invaders." For "seeing" they have a molecule that goes by the name of CD 4 among scientists.

Against precisely this molecule, the Erlangen scientists found about 40 antibodies, that is, by fusion with—then harmless—cancer cells rendered "immortal" and at the same time identically duplicated (cloned) defense cells. One of these so-called monoclonal antibodies, dubbed MAX16H5, which promised to provide a particularly stable relationship with CD 4, was tested on a total of 13 patients over the past two years. They were suffering from rheumatism, against which no other treatment gave them relief.

The result turned out to be so amazing that even Emmrich spoke of an "unexpected success": With three-fourths of these especially difficult cases the pain subsided, the swelling of the joints went down, and the general condition of the patient improved. The subsidence of the inflammation could even be objectively demonstrated by the blood count. The improvement lasted for weeks in some cases, but for months in others. The reasons for these results are puzzling for Emmrich too: "Something is happening here that we don't yet fully understand, but which we would like to comprehend." Now, however, these initial successes must first be clinically confirmed in a Europe-wide study on which research teams from Munich, Basel, and Birmingham also collaborate. Since they will be studied with comparable approaches at these centers.

Neither Frank Emmrich, who developed the method, nor Prof. Gerd Burmester, who was responsible for the

treatment, can or want to conceal the fact that partial paralysis of the immune system is linked with special risks. However, up to now they have been unable to detect a feared increase in patients' susceptibility to infection, only at the most fever or nausea during the first few days.

The antibody may possibly help not only patients with rheumatoid arthritis, but also those with other illnesses from the group of autoimmune forms.

Even though desperate patients are already sending Professor Emmrich blank prescription forms, he warned against premature optimism: "It will be years yet," he estimated further development, "before this form of therapy can be offered on a regular basis."

#### **UK: Researchers Develop Biosensor To Monitor Toxic Gases**

*93WS0439Q Toddington NEW MATERIALS INTERNATIONAL in English Feb 93 p 6*

[Text] Researchers into biosensors at Cranfield Institute of Technology claim to have invested the first biosensor able to monitor gases reliably.

The breakthrough means sensors can be used in health and safety and environmental monitoring for hazardous organic vapours and gases and also enables catalytic conversion in gases to remove toxic material from factory exhausts. It is particularly suitable for the automotive, manufacturing and petrochemical industries.

Professor Tony Turner, head of Cranfield Biotechnology Centre, said: "Many organic vapours and gases are commonly found in the workplace but there are currently no cost effective methods of monitoring them accurately. Expensive equipment such as mass spectrometers can do the job but we have invested a low-cost technology which we want to develop commercially."

The Centre has just won a £300,000 contract under the EC's Environment programme to develop its sensor for three hazardous and toxic gases: phenol vapours (found in the furniture industry, for example); methane; and a gas from the sulphur/nitrogen oxides group, major atmospheric pollutants.

Cranfield Biotechnology Centre's partners in this project are the University of Ioannina in Greece and City Technology, a major UK gas sensor company.

#### **Italy: Gene Bank Screening Center Begins Operations**

*MI1105143493 Brescia BIOTEC in Italian Mar-Apr 93 pp 59-60*

[Article by Daniela Toniolo: "YAC Gene Bank Screening Center Now Operational"]

[Text] The YAC [yeast artificial chromosome] gene bank screening center, organized in collaboration with the

CNR [National Research Council] IGBE of Pavia (Italy), is now operating at the San Raffaele Hospital DIBIT [Department of Biomedical Sciences and Technologies] in Milan. Daniela Toniolo, Cinzia Sala, and Giovanna Torri are responsible for running the center. The purpose of the center is to provide a screening service of the YAC gene banks available to the scientific community and to provide support for those groups in Italy and Europe that use, or propose using, YAC gene banks in connection with their research. The availability of these gene banks, while enormously facilitating the entire screening procedure, also creates certain organizational problems and makes it necessary for specialized methodologies to be developed. These problems should now be resolved or dealt with in the centers being funded by the EC in the various European countries. A complete human gene bank, which has been set up by R. Anand of ICI, is now ready for PCR [polymerase chain reaction] screening. This gene bank consists of 33,600 human clones, each with an average of 200-300 kb, arranged on 350 microtiter slides. The relatively small dimensions of the inserts are compensated for by the low number of cases of co-cloning occurring in this gene bank's clones, (less than 10 percent) when compared with other YAC gene banks.

It is an accepted fact that one of the main problems with using YAC cloning, is the high incidence (more than 40 percent) of cases of co-cloning DNA fragments originating from different areas of the genome. The gene bank of the CEPH [Center for Human Polymorphism Studies] in Paris will soon be transferred to the center. This gene bank has the advantage of containing much longer clones (400-1,000 kb) and is therefore particularly useful when "walking" along a chromosome from a known marker, which is not necessarily close to the area to be cloned. Depending on the level of demand, it could be useful to distribute chromosome-specific gene banks, whether YAC or cosmid as well as well-organized collections of cDNA [copy DNA]. The center will, of course, also function as a distributor for YACs that have already been identified and are of public domain.

At present, only PCR screening can be performed. Screening begins with 40 DNA pools, with pairs of oligonucleotides specially designed to allow a specific 150-400 nt fragment of approximately 25 ng of human genomic DNA to be enlarged by PCR. Primary screenings can be carried out directly by the interested parties, in which case the center sends sufficient DNA from each primary pool so it can be carried out by the center, which is also available to offer suggestions and provide help with the design of the oligonucleotides and with perfecting PCR conditions. Secondary screenings are always carried out at the center, with oligonucleotides forwarded by the research group concerned together with PCR conditions. Any resulting positive clones will be lifted directly from the microtiter [microtitolazione] slides and sent to the laboratory concerned. A colony must be isolated from each resulting positive clone and checked for hybridization as well as for PCR. On request, the center is able to provide clarification and

protocols regarding the methodologies necessary for the characterization and use of the YACs identified. The center is currently also being equipped for the preparation of high-density colony filters for screening through hybridization. Positive screening results from the five European screening centers will be stored in a common database. Information concerning results will be kept confidential for six months, or for up to a year at the request of the group concerned. At present, the center is funded by the EC and screening is free of charge.

### Germany: Genetically Engineered Root Crop Field Trials Licensed

MI0106150493 Munich SUEDEDEUTSCHE ZEITUNG in German 16 Apr 93 p 6

[Text] The Federal Health Office in Berlin has licensed field trials with genetically engineered sugar beet and potatoes. The office has granted the Institute of Gene Biology Research in Berlin a license to release genetically engineered potatoes at Wetze in Lower Saxony. Field trials with genetically engineered sugar beet have also been licensed in Wetze and in Oberviehhausen (Lower Bavaria). The Federal Health Office also stated that the license covers the 1993 and 1994 growing seasons. The Greens in the European Parliament have demanded that the trials be stopped, claiming that the risk is incalculable. The Association for Environmental Protection and Conservation has called the trials "completely unnecessary."

According to the office, a genetic technique has been used to introduce into the genotype of the sugar beet to be released a gene that is intended to make the beet resistant to the pathogenic agent of the rhizomania virus, which has hitherto caused up to 50-percent yield losses. The virus is transferred by a ground fungus, and prevents the sugar beet from forming a proper rhizome, making it shrivel up completely, hence the name rhizomania. Around 25,000 hectares of sugar beet a year are said to fall prey to this virus throughout Germany.

With the potatoes, two trials will take place on using the crop to supply raw materials. One trial will involve planting potatoes outdoors that have been genetically engineered to produce a certain kind of starch that is better suited for use in the paper and textile industries than the starch from ordinary potatoes. According to the authority, a potato that is expected to develop larger rhizomes following the insertion of a gene from baker's yeast will also be tested.

The license has been granted with the approval of the Federal Environment Office in Berlin and the Federal Biological Institute for Agriculture and Forestry in Braunschweig. According to the latest scientific information, "no damaging implications for the life or health of man, animals, or plants, or for the remainder of the environment" were anticipated. The license lays down ancillary provisions and conditions. The trial areas must be marked with signs indicating that the plants have been genetically engineered and are not intended for

consumption. On conclusion of the trials, it must also be ensured that no plant residues capable of propagation remain in the soil.

In Germany, there has so far been only one field trial with genetically manipulated plants, in which petunias with artificially altered colors were studied in Cologne in 1990-91. In Bavaria, the Technical University of Munich has now applied for a further field experiment. A trial involving genetically-altered maize and rape plants at Emmering in the Fuerstenfeldbruck region of Upper Bavaria will study the effect that the cultivation of genetically engineered plants has on the environment.

## COMPUTERS

### Cray Supercomputer for National Academic Network

93WS0005A London *THE DAILY TELEGRAPH*  
in English 23 Feb 93 p 18

[Article by Christine McGourty, Technology Correspondent: "Supercomputer To Aid Academics"]

[Text] The most powerful computer in Britain for academic researchers was inaugurated yesterday by Mr. Waldegrave, minister responsible for science.

Called a Cray Y-MP, the so-called "supercomputer" has three times the power of its predecessor and can carry out a maximum of 2,700 million calculations per second.

Supercomputers are crucial in areas such as environmental research, weather forecasting and drug design and are being used for economic forecasts.

Mr. Waldegrave said the Cray—at the Science and Engineering Research Council's Rutherford Appleton Laboratory in Didcot, Oxon—had "truly awesome power." British scientists could now take on some of the large computational projects which hitherto could only be tackled abroad.

"It will allow research in a whole range of disciplines from charting global warming and climatic behaviour to structure of new materials and industrial processes."

The Cray Y-MP will be connected to the national computer system known as Janet (Joint Academic Network) to allow researchers from all over Britain to use it remotely.

Mr. Waldegrave said the capacity of the network would be increased by a factor of 100 when Janet was replaced by a superior network, Superjanet, this year.

But Dr. Brian Davies, RAL's associate director of computing, said Britain had slipped down the league of supercomputing nations and had less power available per head of the population than Japan or Germany.

A report from the Parliamentary Office of Science and Technology said that even Mexico had more supercomputer power for its universities than Britain.

Researchers fear the slide could jeopardise Britain's industrial competitiveness and its lead in several important areas of science.

Rivals to Cray, the computer company, claim to have machines that run at speeds more than 10 times faster than the Y-MP.

### Germany: Research Ministry Funds Bioinformatics Project

MI1105142493 Bonn *TECHNOLOGIE-NACHRICHTEN*  
*MANAGEMENT-INFORMATIONEN* in German  
30 Mar 93 pp 3-4

[Text] "Optimization Strategies in Bioinformatics-Evolutionary Algorithms" is the name of a new research project funded by the BMFT [Federal Ministry of Research and Technology]. Findings in evolutionary biology are being used for computer science purposes. The bridge between computer science and biology is being strengthened in a future-oriented field and thus opened up to information science.

The BMFT is providing funds of 10 million German marks [DM] for the project between 1993 and 1996.

The efficiency of the information processing processes that enable living systems to achieve optimum adaptation to the natural environment over long periods of their phylogenetic development has aroused great interest among mathematicians and computer scientists, and also among engineers and natural scientists. They regard evolutionary algorithms, which describe evolutionary processes and shorten them drastically after installation on rapid computers, as an outstanding opportunity to solve complex optimization problems that cannot be mastered with conventional mathematical methods.

Evolution should be understood as a learning process that stores successful innovations and discards unsuccessful ones. Molecular biologists and population geneticists have identified five essential components of evolution: replication (copying genetic information), recombination (mixing genetic information), mutation (faults in the passing on of genetic information), selection, and isolation. These principles can be translated into algorithms and ultimately into computer programs, and used to evolve suitable models. The high computing speed of modern computers makes it possible to process mathematical problems using evolutionary algorithms in which a large number of solutions are fed back, evaluated, and calculated afresh.

Evolutionary algorithms are being developed for applications in virtually all areas of the economy in which conventional mathematical methods are inefficient or



unsuitable because of the huge amount of data involved. Some conventional optimization processes cannot even cope, for example, with the relatively simple problem of determining the optimum ignition performance of spark plugs. For the entire performance characteristics of the spark plug, which range over all of two parameters (excess air and fat content of the mixture), all the conceivable pairs of parameters must be generated and evaluated in terms of the resulting ignition performance. Even for problems with five parameters, about 10 billion computing operations are needed to scan all the possibilities, and even the most advanced computers cannot cope with this in reasonable time.

Such highly complex problems occur, for example, in the following areas of application:

- computer-aided design of optimum systems;
- minimization of the network structure of information systems;
- collision avoidance in robot systems;
- planning optimum machine utilization in terms of space and time;
- structure and parameter optimization in the chemical industry;
- aerothermodynamic efficiency optimization of turbo machines;
- layout optimization in optical system and highly integrated circuit design;
- self-structuring of highly networked neural systems;
- folding prediction in proteins.

Computer science itself receives a new impetus from the evolutionary algorithms for the further development of expert systems and for the structural optimization of artificial neural networks.

The efficiency of evolutionary algorithms can also be considerably increased by using parallel computers, on which they can be implemented particularly well.

#### **Germany: Parallel Computing Project Results Reported**

*MI0206080293 Bonn TECHNOLOGIE-NACHRICHTEN  
MANAGEMENT-INFORMATIONEN in German  
30 Mar 93 pp 7-8*

[Text] New solutions in the development of configurable, massively parallel computers are becoming possible as a result of project results obtained at the Association for Mathematics and Data Processing mbH (GMD) Research Institute for Computer Architecture and Software Engineering. The MANNA (Massively Parallel Architecture for Numerical and Non-Numerical Applications) research project, which was carried out

with Federal Research Ministry support, is implementing as a prototype development innovative ideas for the hardware and operating software of a massively parallel architecture with a common virtual memory.

According to the recommendations of the Rubbia Commission, which has drawn up proposals for the EC for work in this field, Europe must invest heavily in this area of supercomputing in order to gain recognition as a partner on a par with Japan and the United States by the end of this century. Among other measures, parallel computing R&D will be stepped up.

MANNA is a pilot project whose research results represent important contributions to the development of architectures suitable for parallel computers ranging from super workplace computers with a capacity of about 1 billion operations per second to massively parallel super computers in the capacity range of about one teraflops [trillion floating points per second]. One teraflops is the astronomical number of one trillion ( $10^{12}$ ) operations per second.

Such capacities cannot be achieved with conventional computers. They are made possible by an architecture design whereby a computer consists of a large number of microcomputers cooperating with one another. The individual microcomputers are, in turn, composed of a high-performance microprocessor with a sufficiently large memory and all the other facilities required for such a structure to operate as an independent computer. A parallel computer is composed of a number of such microcomputers. At present, this number may range from 16 to about 10,000. Such a system is completed by a special linking device that enables the microcomputers to communicate with each other. Such parallel computers both offer a much higher performance than conventional computers and are also much cheaper because of the low costs of microcomputer technology.

The problem that has so far prevented these parallel computers from being used more widely is that they are difficult to program. Programming poses special requirements that the normal user is scarcely able to meet. For this reason, parallel computer development requires innovations not only in hardware and system software, but also in the way they are used, which, first and foremost, requires the development of novel, more suitable programming models. This is a research topic of particular relevance, as even a top-performance computer system is of little use if the users are unable to handle it.

One solution to the problem is to use a software layer to create one abstract machine, although the computer is physically composed of many individual microcomputers, and this abstract machine therefore appears as a monolithic single computer for programming purposes and, consequently, to the user. This requires special measures in the hardware and software architecture of the parallel computer. To date, however, this has not

been possible without considerable losses of performance, i.e., programming convenience was achieved at the expense of a large part of the additional performance potential achieved by parallel computing.

The MANNA research project had led to new and better solutions to this problem. Optimum parallel computer hardware and software architecture design retains the programming advantages without appreciably reducing the potentially high performance of the parallel computer. Some of these novel ideas have already been taken up in commercial developments in Europe, Japan, and the United States. More specifically, the MANNA project results include the following pioneering achievements:

- The development of configurable, hierarchical crossbar topologies as a particularly efficient and economic linking structure, by means of which the microcomputers can communicate in a minimal amount of time;
- Objective PEACE, a configurable family of parallel network node operating systems that allow the user to select those particular operating system functions that he really needs so that he does not have to waste time on unnecessary administration;
- A new, more efficient form of organization for the abstract machine that presents the system to the user as an individual computer;
- The parFORTRAN compiler, which automatically parallelizes a user program written sequentially in the conventional way, so that the user does not need to do it himself;
- The parLISP system for parallel symbol processing, for artificial intelligence applications for example;
- VISA, a top-performance 3D graphics system with shadowed surface display according to the high-quality Phong process.

The table below gives an overview of the performance of the single MANNA node computer. The prototype has 16 of these node computers, which means that the performance stated in the table should be multiplied by 16 to obtain the total capacity. Its compactness is obtained by using large-scale integrated circuits, which also comprise highly integrated components (ASICs [application-specific integrated circuits]) specially developed for this computer. The MANNA architecture could be expanded to an upper limit of 10,000 node computers.

The project does not, however, aim to develop a product, as this is not a job for a research institute. The aim is rather to stimulate parallel computer development with new ideas and to demonstrate its feasibility and efficiency.

Another aim is to obtain a test bed suitable for the validation of new program paradigms such as the

common virtual memory or a parallel LISP, or even more innovative and even more compatible program models for the future.

**Performance Data of a MANNA Node Computer**

Node processors	2 x i860XP
Peak node capacity	100 NUPS
200 Mflops*	100 Mflops**
Node memory	32-Mbyte DRAM
Access bandwidth	400 Mbyte/s
Network bandwidth per node	100 Mbyte/s
Network bandwidth per cluster	Nx100 Mbyte/s***
Maximum number of nodes	12,000
Coolant	Air

\*single precision, IEEE standard—\*\*double precision, IEEE standard—\*\*\*N = number of computers.

## DEFENSE R&D

### France, Sweden To Develop Antitank Shell

93WS0446E Paris L'USINE NOUVELLE/  
TECHNOLOGIES in French 15 Apr 93 p 46

[Unattributed article: "Franco-Swiss Agreement on Smart Shell"]

[Text] Three days before stepping down as defense minister, Pierre Joxe signed a cooperation agreement with his Swedish counterpart, Anders Bjoerk, for the development and production of an intelligent shell. Launched by 155 mm artillery, the Bonus will be able to pinpoint and destroy tanks at distances of more than 25 km. The device will contain two plasma submunitions, equipped with infrared detectors made by the French firm Inter technique. The two joint industrial prime contractors will be Giat Industries for France and Bofors for Sweden.

### Eurocopter Hopes to Launch Tiger in 1993

93WS0472A Paris AFP SCIENCES in French  
22 Apr 93 p 12

[Unattributed article: "Eurocopter Believes It Absolutely Must Start Tiger Industrialization in 1993"]

[Text] Paris—According to a statement made on 20 April by Mr. Jean-Francois Bigay, the Eurocopter chief executive officer, the French-German helicopter manufacturer believes that it must absolutely launch the Tiger industrialization in 1993—one year earlier than projected—if it wants to be able to answer the invitations to bid that many countries, including Great Britain, are about to issue.

"The design of this French/German combat helicopter is set. It will not change any more. There is no technical reason to postpone the industrialization decision," Mr.

Bigay stated. In addition to Great Britain (about 100 units), Spain and the Netherlands might be interested in the helicopter, the first units of which are scheduled for delivery in 1999. But it seems that Germany wants to postpone the decision "until after the year 2000," according to Mr. Bigay.

For Mr. Bigay, the French-German company must "be in a position to deliver a simplified "export version" of the Tiger" by 1997-1998, which would imply that manufacturing should start this year. This decision will require France and Germany to make 1 billion French francs [Fr] available, each country contributing one half. "We are not asking for more money; we are asking that the industrialization decision be advanced by one year," Mr. Bigay pointed out, stressing the importance of such a decision to ensure continued European representation in the military helicopter sector. Last year, Eurocopter obtained 52 percent of the civilian market worldwide, but less than 15 percent of the military market, due to its U.S. competitors' aggressive marketing.

Eurocopter has been preparing for lean years and expects to reduce its sales to about Fr10.5 billion (compared with Fr11.6 billion in 1992). "We do not see how sales could be higher in 1993 and 1994," Mr. Bigay added. During its first year of existence, Eurocopter, which was formed in 1992 by the merger of the Aerospatiale and Daimler-Benz helicopter divisions, made a net consolidated profit of Fr25 million, which it intends to raise to Fr150 million in 1993.

## ENERGY, ENVIRONMENT

### German Company Uses Pyrolysis, High-Temperature Gasification in New Waste Disposal Process

93WS0427A Duesseldorf VDI NACHRICHTEN  
in German 19 Mar 93 pp 1, 32

[Article by cf and Martin Boeckh: "Waste Disposal Without Waste Gases"]

[Text]

#### Trash Becomes Energy

A new method of trash disposal called Thermoselect is causing a stir now. Thermoselect combines two known steps. First, the trash is converted into high-energy components under anaerobic conditions (pyrolysis). The following high-temperature gasification creates a synthetic gas from these components. This gas is used to produce energy. At the same time, mineral and metallic slags are formed, which agglutinate some of the pollutants. The remaining pollutants are transferred into water by means of multi-stage flue-gas scrubbing so that the system does not need a smokestack. Several German communities have already announced their interest in the method with the Swiss manufacturing company. (p 32)

### Thermoselect Combines Pyrolysis and High-Temperature Gasification Into a New Waste-Disposal Method

#### Trash Incineration Without a Smokestack

#### Pollutants From Waste are Collected in Granulate and Waste Water

A new method for thermal trash disposal is making a stir now. Pyrolysis coupled with high-temperature gasification—an initial Thermoselect plant is operating successfully in Italy using this principle.

Trash incinerators are a hot potato. They are needed everywhere but no one wants to have one. According to the information from Umweltservice Sudwest Entsorgungs-GmbH (USEG), a subsidiary of Badenwerk AG of Karlsruhe, 20 to 30 trash incinerators are being considered for construction in Baden-Wuerttemberg alone. The acceptance level for new incinerators is, however, low among the population of this Land.

A new method might have better a chance. It is coming onto the market under the company and method name of Thermoselect. The method has already been implemented in a pilot plant. This plant commenced operation this past year in the Italian province of Verbania near Fondotoce.

According to claims of the developers, Thermoselect is a "new concept for extracting energy and raw materials from all types of waste." In Thermoselect, nitrogen oxides and other pollutants, such as dioxins and furans, are not created in the first place. It does not matter whether domestic, industrial, special waste or sewage sludge is undergoing treatment.

Four process steps characterize the system. These are mechanical pretreatment to compress the waste; degasification and conversion into carbon; gasification in a high-temperature reactor; and the following, multi-stage gas and water purification step.

First, a 1000-metric-ton scrap press reduces the volume of the incoming trash to about 10 percent. The greatly compressed packets of waste are "cooked" in a degasification channel at temperatures up to 600°C. During this process, organic waste is converted into carbon that solidifies together with the inorganic, mineral and metallic residual material to form briquettes.

From the degasification channel, the briquettes are pushed into the high-temperature reactor after two hours by the resupply of new trash packets. Under the metered addition of pure oxygen, all solid components, such as metals, minerals, and glass, liquefy completely at temperatures of about 2000°C. Some of the heavy metals and other pollutants are agglutinated permanently during this process. Components containing carbon are gasified.

In a second reactor, the remaining carbon is incinerated and metallic and mineral melts separate at temperatures of about 1600°C. The manufacturer claims that building

materials and fillers can be produced directly from the internal, glasslike mineral melts using the energy inside. On the other hand, the metallic melts are to be returned to the metal industry as raw material.

The gas created in the degasification channel is essentially water vapor ( $H_2O$ ), carbon monoxide ( $CO$ ), carbon dioxide ( $CO_2$ ), hydrogen ( $H_2$ ) and methane ( $CH_4$ ). This gas also flows into the reactor and has been heated after staying more than 4 s at a temperature exceeding  $1200^\circ C$ . At the high temperatures of the reactor, all organic compounds are completely destroyed and decomposed into their atomic components. So that neither dioxins nor furans can be created even during the subsequent cooling, the synthetic gas is shock-cooled to about  $90^\circ C$  using injected water. Traces of heavy metals that are carried along condense with chlorine and hydrogen fluoride particles later. The synthetic gas is then subjected to an acidic gas scrubbing followed by a basic gas scrubbing to separate out pollutants such as hydrochloric and hydrofluoric acids, remaining heavy metals and sulfur compounds. After being further cooled to  $5^\circ C$  to reduce the water content, the gas is next fed through two activated charcoal filters.

Finally, for each metric ton of trash, 600 kg of synthetic gas is available. This gas consists of up to 35 percent  $H_2$ , 40 percent  $CO$ , 20 percent  $CO_2$  and the remainder of  $CH_4$  and nitrogen  $N_2$ . In the Italian pilot plant, half of the energy from the synthetic gas is used to power the plant. The remainder is burned off. "Using gas motors, about 300 kWh of electrical power can be generated for each metric ton of domestic trash," states Prof. Rudi Stahlberg. He is the director of the Thermoselect Research Department.

As most of the parts of the plant, the waste water treatment system of the individual scrubbing solutions also consists of conventional process steps: the heavy metal compounds are separated after precipitation of the sulfur compounds and the remaining solutions are evaporated. "Our method produces no waste water," claims Stahlberg. For good measure, the water is released into the atmosphere by means of a wet cooling tower.

About 0.5 kg of dust, 2.2 kg of heavy metals and 18.8 kg of sodium salts for each metric ton of trash must be disposed of from the waste water purification system. If a buyer is not found, this also applies to the 30 kg of metal and 263 kg of glasslike synthetic products from the melt. These are amounts that have no competition when compared to conventional trash incinerators. From these conventional systems, 400 kg of slag, ashes and toxic filtrates must be disposed of for each metric ton of trash. In addition,  $8600\text{ m}^3$  of flue gases must be purified.

The pilot plant has been operating since October 1992 with an hourly throughput of up to 4.2 metric tons. With this in mind, even the Rhineland-Westphalian Technical Control Board (TUV) came to the conclusion that "the

small amount of impurities found in the purified synthetic gas independent of the selected incineration process provide expected pollution emission values that lie considerably below existing limit requirements." Concerning the composition of the granulate, according to TUV, the amount of impurities in the eluate is so small that the requirements of the Technical Guideline for Community Waste are met. The material can be placed in a dump without any special precautions. The extent to which the operational safety of the plant satisfies German requirements is to be investigated in the coming months.

Not all questions on the method have been completely answered. Working with extremely high temperatures and the chemical aggressiveness of the acidic waste gases might cause technical problems, according to the Association for the Environment and Protection of Nature of Germany (BUND).

In spite of this, USEG has already stated its commitment to offer for sale only the Thermoselect method in Baden-Wuerttemberg. "The first plant could start operation as early as 1996," said Klaus Weiss, a member of the board of directors of USEG. Even the large electricity producer RWE from Essen considers the method to be a possible alternative. Andre Bauguitte is from the RWE Entsorgungs AG. He emphasizes, "We were interested in Thermoselect at a very early point." However, they want to wait for the final TUV report in Essen.

#### **Germany: Environmental Research at Cologne University Described**

*MI0206081293 Bonn WISSENSCHAFT  
WIRTSCHAFT POLITIK in German 7 Apr 93 p 4*

[Text] Cologne University has become an environmental research pole.

Not only numerous natural scientists, but also legal experts, economists, doctors, and educators are engaged in this field of research at Cologne University. This was how Professor Peter Mittelstaedt, prorector for research and scientific junior staff at Cologne University, summarized the situation when submitting the research report for 1991. It offers a complete overview of an impressive 2,174 research projects on which scientists at Cologne University were working in 1991. During the same period, 4,910 books, essays, and articles were published by Cologne researchers.

Prof. Mittelstaedt gave some examples: A team at the Institute of Mineralogy and Petrography is working on improving highly efficient flue gas scrubbing plants used during the incineration of noxious waste. This project, which is funded by industry, is developing an analytical system for measuring particulates and condensates that will help optimize process parameters and further the emission of pollutants. Another industry-funded project is also examining the suitability of clays for lining waste dumps.

## Germany: Automobile Scrap Recycling

### New Plant Being Built

MI0106151393 Bonn DIE WELT in German  
13 Apr 93 p 12

[Text] Federal Environment Minister Klaus Toepfer has called for German automobile manufacturers to take "responsibility for their products from the cradle to the grave." Laying the foundation stone for a new automobile scrap recycling plant in Halle, he said last week that he wanted ease of recycling to be in the producers' own interests.

Central German Recycling and Disposal GmbH Halle is constructing its own modern car recycling plant near Halle, in which 1,000 scrap vehicles per year—including the Trabant and Wartburg brands—will be dismantled, in the future and a proportion of their components reused. Investments to the tune of 6 million German marks [DM] will be required by the time the plant is completed in about two years' time. The company is working with ADAC [General German Automobile Club], Preussag Auto recycling, and Ford. Preussag AG is planning to set up a network of 100 dismantling centers throughout Germany by 1998. The investment required amounts to about DM700 million.

### Manufacturers Protest

MI0106151893 Bonn DIE WELT in German  
13 Apr 93 p 12

[Article by Frank Elsner: "Dispute Over Car Scrap Ordinance—Manufacturers Against Taking Cars Back Free of Charge—Environmentalists Criticize Low Level of Recycling"]

[Text] If Federal Environment Minister Klaus Toepfer has his way, German car drivers will dispose of their old vehicles in the following way in the future: They will take their metal darling to a recycler for the company that manufactured it, who must take back the vehicle. It will not be a long journey, because the manufacturers are setting up a take-back or collection system that is "at least as dense as the sales network." The final owner incurs no costs unless he has stripped the vehicle of serviceable parts beforehand or soiled it badly. For models licensed before the regulation is issued, a charge is made only if the disposal cost exceeds the proceeds from recycling.

The recycler must first "dry out" the vehicle, that is, remove the oil, gasoline, and other operating fluids. As many components and materials as possible are then dismantled and used as spares or recycled as materials. However, Toepfer's ministry does not give binding recycling quotas; they are only to be regarded as "targets," for example, 20 percent of plastics by 1996 and 50 percent by the year 2000. Moreover, automobile manufacturers are urged to take recycling into account in the development stage.

This scenario is set out in the Automobile Scrap Ordinance annexed to the Waste bill before the federal cabinet. It is intended to replace the previous shredder method (scrap press), whereby only the metal parts of cars—about three-quarters of the weight—can be used in steel works, while the remainder—glass, rubber, and plastics—end up on the dump. As some of the substances are highly toxic, the residues, amounting to about 450,000 tonnes per year, are regarded as special waste, the disposal of which costs between 400 and 800 German marks [DM] per tonne.

The process now planned by the Environment Ministry for the 2.6 million vehicles that are scrapped every year is, however, meeting with protest from the manufacturers. For two years they have been seeking a joint recycling strategy in the "Automobile Industry Car Scrap Recycling Project" (PRAVDA) in close cooperation with the branch association, the VDA [Association of German Automobile Manufacturers].

The point at issue is, firstly, the obligation to take back automobiles free of charge, which, according to the head of PRAVDA, Gunter Zimmermeyer, would increase the purchase price of the vehicles. A variable pricing system whereby the disposal costs were deducted from the residual value would be more lucrative for the owner and would provide an incentive to keep a car in good repair.

On the other hand, the target recycling quotas were "simply plucked from the air," said Zimmermeyer. BMW calculates that meeting them would require three times more energy in some cases than the amount required to produce the materials from scratch. "This rigid ordinance must be made more flexible," is the resounding cry to Toepfer. In plain terms, the automobile industry wants to decide on its own how to dispose of its products.

Environmental groups consider the quotas too low, however, and point to a study by the North Rhine-Westphalia Trade Ministry. Using tougher limits, it calculated that the shredder residues would fall very little by the year 2000 in view of the increased proportion of plastics and the manufacturing boom. According to Thomas Lenius from BUND [German Environment and Nature Conservation Association], moreover, quotas that were merely targets offered "little incentive to industry."

### Advanced Technologies

MI0106152193 Bonn DIE WELT in German  
13 Apr 93 p 12

[Text] The current recycling strategies of the automobile industry present a varied picture. A WELT survey revealed that technologies which in some cases have



already been extensively developed are often faced with insufficient recycling capacities.

For instance, the annual capacity of BMW's pilot dismantling works in Landshut, which has been in existence for two-and-a-half years, is currently 1,200 vehicles, whereas domestic sales stand at about 245,000 units. With only six companies, all the BMWs ever produced can be disposed of. The main objective is a dismantling-friendly vehicle design, which can be achieved by systematically identifying and standardizing all the components. When the components can no longer be recycled, the material is used. For example, the insulating material for the floor of the third-series BMW is made from old seat covers.

Opel AG is working on similar lines. Items with a fairly large surface area such as dashboards and door panels are produced from pure and uniformly marked plastics and can be used up to seven times. In Opel's opinion, tires should be burned in power stations in view of their combustibility. This would, however, require appropriate filter units. So far, however, the Russelsheim-based company gives a take-back guarantee only for the Astra.

Mercedes-Benz is now on the lookout for a steel works for a process developed by the Linz-based Voest steel company: In the metal recycling process, the vehicle frame is dismantled and fed into a cupola furnace for steel production. According to Mercedes, the energy content of the organic materials makes for up to a 40-percent saving in primary energy. The process is claimed to be particularly suitable for scrap and used vehicles with limited dismantling potential, which are taken back without exception by the Stuttgart-based company. The Darmstadt Ecology Institute has expressed the criticism that insufficient consideration was given to the dioxin given off during incineration.

Audi AG regards itself as a "pioneer" of plastics recycling. The company collects materials from scrap vehicles via the VW/Audi customer service, and uses them in production, for example, for the bumpers of the new Audi 80. The Ingelstadt-based company said that plastics that could not yet be recycled were meanwhile being replaced by more environment-compatible plastics.

#### **Consortium Solutions**

*MI0106152693 Bonn DIE WELT in German  
13 Apr 93 p 12*

[Text] A united stand against car waste: Joint European and local-level systems are now a reality. Last December five manufacturers—Citroen, Fiat, Peugeot, Renault, and Volvo—formed the "European Car Manufacturers' Recycling Group" (Eurhekar). It aims to set up an international network of take-back and recycling plants, to which end its five members intend to make use of their 6,000 dealers all over the republic, who will take back old cars, quote the owner a price, after consultation with the recycler, that includes the cost of transporting it

to the dismantling center, and issue the owner with a recycling certificate. Contract carriers will then take care of transport to the dismantling plant.

Eurhekar estimates that its models account for about 20 percent of the 2.6 million cars scrapped annually, and considers 100 licensed recyclers in Germany to be sufficient. The operation is being monitored by the Bavaria Saxony TUV [Technical Supervisory Board], whose manager Peter Hupfer also welcomes other automobile producers within the EC single market: "We are not a closed club."

A recent development in the Ruhr area is the Automobile Recycling Association (ARiV), a consortium of 16 companies that want to combine their knowhow to overcome the problem of car scrap in their region. Participants include producers (Opel and Ford), disposal companies like market leader Thyssen-Sonnenberg, and also energy and chemical companies (Ruhrkohle/Hoechst).

ARiV calculates that 15 dismantling plants with a capacity of 40 vehicles per day are required in the Rhine and Ruhr region to dispose of the scrap models in the correct way. If the 100-million German mark [DM] project is to be implemented, however, ARiV anticipates that the owner will incur costs that cannot be covered by the recycling proceeds. "With existing technologies, there is a DM300 to 400 shortfall per passenger vehicle."

#### **Germany: Slow Progress Made With Polluted Sites in Eastern Germany**

*MI0206085693 Bonn DIE WELT in German  
13 Apr 93 p 11*

[Text] Environmental pollution continues to be a major obstacle to investment in eastern Germany. Saxony-Anhalt's Environment Minister Wolfgang Rauls (FDP [Free Democratic Party]) has described the federal-laender agreement of four months ago on sharing the costs of ecological reclamation as inadequate.

According to Rauls, no significant progress is being made with the more rapid and generous release of Trust Agency firms from liability for polluted sites intended under the agreement. Of 9,000 applications submitted in Saxony-Anhalt, only 14 have so far been approved, and only about 80 of the over 60,000 applications from the new laender as a whole. Rauls believes the reason lies in the Trust Agency's restrictive interpretation of the agreement.

The administrative agreement of December 1992 established that the Trust Agency would meet 60 percent of the costs of reclaiming polluted sites, rising to 75 percent for major chemical and brown coal projects: The "remainder" would be met by the land concerned. However, where firms have already been sold, this 60:40 ratio is intended to apply only in cases where the Trust Agency undertook to meet reclamation costs in the privatization contract—and this was the exception

rather than the rule in the 1992 sales contracts. Furthermore, the sums agreed for release from liability have frequently been, and continue to be, well below the actual liability risk. The laender are consequently left with residual liability on an incalculable scale.

Rauls also criticizes the fact that the Trust Agency shares the costs neither for firms expropriated in the seventies and reprivatized, nor for those with no prospects of privatization. However, experts believe that it is the least economically viable firms that tend also to be the ones with the greatest ecological pollution. According to Rauls, "the sites must be cleaned up in any case, whether the firms are privatized or liquidated." Thus, Saxony-Anhalt is on its own as far as cleaning up the highly polluted, closed Ilseburg copper mill is concerned, the reclamation costs for which are put at around 63 million German marks [DM].

In a bid to speed up the pace of reclamation effectively, Saxony-Anhalt's environment ministry has submitted to the federal government a proposed solution, though without success so far. His proposal is for the Trust Agency to open up the allocation that is scheduled to disburse DM1 billion a year over the next 10 years to cover all polluted sites for which it is responsible.

#### France To Decree Battery Recycling

BR0505145493 Paris *ELECTRONIQUE*  
*INTERNATIONAL* HEBDO in French 15 Apr 93 p 11

[Article by Didier Girault: "Batteries To Be Collected and Recycled"]

[Text] The recovery and recycling of batteries should soon become obligatory, by decree. This decree will apply to the collection of mercury-oxide batteries as of next September. The French association of battery manufacturers and importers is protesting. The first repercussion of the Desgeorges report on the recycling of electronic, electrical, and electrical engineering products is a draft decree on the recovery and recycling of batteries and accumulators, which has now been submitted to the French Council of State. This draft decree establishes an obligation to collect and recycle mercury-oxide batteries as well as lead and cadmium/nickel batteries as of September 1993. The 8 to 9 million mercury-oxide batteries sold on the French market every year (figures for 1991) contain several metric tons of mercury (no more than three), one of the main sources of environmental pollution. As of 1995, the decree will also apply to long, thin, pencil-shaped batteries, some 500 million units of which are sold in France each year (figures for 1991). This is the point most hotly contested by the French association representing electric battery manufacturers and importers, a member of FIEE (Federation of Electrical and Electronic Industries). The association alleges that the "public authorities, without taking account of the opinion of the profession, decided to extend the field of application of the draft decree drawn up in cooperation with industry representatives in

December 1992, to include all batteries. Apart from mercury oxide, batteries contain practically no heavy metals and are therefore nontoxic." The trade association objects to the government's justification for the measure, arguing that "the public authorities have done nothing to provide for methods of recovery and recycling," and "recycling technology is not yet industrially operational or economically viable."

Europile, an association of European battery manufacturers and importers, has launched, in cooperation with its Japanese and American counterparts, a feasibility study on the pyrolytic recovery of heavy metals. The technique presently considered most effective in recovering mercury is Recymet. This is a Swiss pyrolytic process which costs some 30,000 French francs [Fr] per processed metric ton, according to data from the French association of battery manufacturers and importers. The process has supposedly not yet been fully perfected.

In practice, according to the decree now before the Council of State, distributors with at least 1,000 square meters of commercial floor space would be responsible for collecting used batteries and would have to create specific facilities for such collections. As for the processing plants [required], none has yet been built in France.

#### Switzerland: Emissionless Waste Incinerator Prototype Developed

BR1005150593 Rijswijk *POLYTECHNISCH*  
*WEEKBLAD* in Dutch 16 Apr 93 p 1

[Article by Eelco van der Linden and Gerard van Niftrik: "Waste Incineration Without Smoke Emissions"]

[Text] Fondotoce/Locarno—The worst thing about waste incineration plants is that they have chimneys. Waste incineration plants are regularly discredited for releasing toxic substances, such as dioxins, into the atmosphere. This is precisely why the Swiss company Thermoselect (of Locarno) has developed an incineration process which does not release any flue gases. A pilot plant in Fondotoce, Italy, seems to be working very well. Germany is even considering the large-scale introduction of the system.

Gudula Freytag, spokeswoman for Thermoselect, attempts to remain business-like, but she can barely contain her enthusiasm. "Every day we get dozens of phone calls from all over the world," she says. "We are pretty amazed ourselves."

The Technical University of North Rhine-Westphalia (TUV, Essen) recently conducted research into the emissions and residues produced by the new process. The results were recently published and have really gotten things moving. Freytag will not go so far as to talk of a revolution, but she does emphasize the impact of the results. "If the standards which will apply in Germany as of 1995 are set at 100, we would score one."



### Hospital Waste

The Swiss company claims that the process is suitable for processing all kinds of waste, from domestic to hospital refuse.

A fairly large-scale pilot plant has now been operating for eight months at Thermoselect's Italian base in Fondotoce, near Lake Maggiore. The method it uses is based on pyrolysis and gasification techniques.

The process involves four stages. First, a scrap metal press is used to reduce the volume of the delivered waste to approximately 10 percent of its original volume. Second, the highly compacted parcels of waste are heat-treated in a tunnel furnace. In this furnace, organic material is converted into carbon at a temperature of 600° C. This produces a type of briquette which is subjected to intensive treatment in the next stage of the process. All the metals, minerals, and glass contained in the briquettes are smelted out at 2,000° C in a high-temperature gasifier, while hot oxygen is added in specific doses. Most of the carbon components are gasified during this process; heavy metals are immobilized in the smelted material.

The fourth and final stage takes place in a second reactor, at a temperature of 1,600° C. Here, the remaining carbon components are incinerated and the smelted minerals and metals are separated. From the mineral fraction, a glass-like material can be made which can subsequently be used as a building aggregate. The cooled molten metal is a valuable raw material which can be sold to the metal industry.

### Electricity

The gases produced during the first phase of the process are also passed through the high-temperature reactor. Their temperature increases to well above 1,200 degrees. At this temperature, harmful substances such as furans and dioxins disintegrate.

The result is a synthesis gas from which the chlorine and fluorine components are removed through condensation after rapid cooling. The gas is then washed several times, before finally being passed through an active carbon filter.

The plant in Italy uses this gas to meet its own energy requirements. For the time being, the excess gas is burned off. This is rather unfortunate, but the ultimate aim is to make more efficient use of this energy. Thermoselect claims that 1 metric ton of domestic refuse can generate 300 kW of electricity.

### Germany

The success of the Thermoselect process does, of course, partly depend on finding markets for the residues. For this reason, the TUV has conducted leaching tests on the vitrified residues, which so far have proved positive. Although the research has not been completed, the researchers have already concluded that the material is

suitable for dumping without the need for extra precautions. It remains to be seen whether it also meets the requirements for applications in the construction industry. Further research over the coming months should answer this question.

Although the final results are not yet available, expectations are high, especially among our German neighbors. Freytag confirms the high level of interest shown. "Germany is on the point of building a great many waste processing units and seems to prefer thermal plants. In Baden-Wuerttemberg, Badenwerk alone has already taken out an option on 20 Thermoselect plants."

A standard factory consists of two processing lines and costs 180 million German marks. This type of plant has an annual capacity of 150,000 metric tons and produces approximately 10-11 MW of electricity, of which the plant itself needs 4-5 MW, according to Thermoselect.

## FACTORY AUTOMATION, ROBOTICS

### SKIDS Project Develops Factory Supervisor

93WS0446D Paris L'USINE NOUVELLE/  
TECHNOLOGIES in French 15 Apr 93 p 15

[Article by Anne Lombard: "SKIDS Hunts Down Problems"; first paragraph is L'USINE NOUVELLE/ TECHNOLOGIES lead]

[Text] A European project has produced a multisensory machine for factory supervision.

SKIDS (Signal and Knowledge Integration with Decisional Control for Multisensory Systems), an ESPRIT [European Strategic Program for Research and Development in Information Technologies] project, has just given birth to an intelligent factory supervisor. "This specific application is intended only as a demonstrator to validate a generic architecture for merging multisensory data, or, in other words, a general approach that can be transferred to other sensors and thus other situations," says Anne Lalo, project leader and engineer at Matra MS21.

The demonstrator built by the project partners consists of a shop divided into six zones equipped with stationary and mobile sensors (cameras, odometer, sonar, etc.). A conveyor and/or operator move about the shop. The demonstrator validates the platform's ability to detect changes in this known environment by pinpointing anomalies. The "model bank"-equipped platform is capable of space-time correlation.

If a box falls and blocks the passage because the operator loaded the conveyor improperly, the sensors detect the incident. Two merge modes come into play: a merge of single-source, homogeneous digital data and a heterogeneous, or symbolic, merge (between two vision nodes, e.g., the optical barrier-camera unit).

On this basis, the machine identifies, characterizes, locates, and generally "pursues" the source of the anomaly. It inventories its resources and may seek additional information. It can request the mobile camera to explore a dead angle or perform a three-dimensional check. Detection and interpretation are done on a semi-real-time basis. Once the event is identified, the operator intervenes and puts the box back on the conveyor.

Future projects for SKIDS will involve changing environments, for which the platform will be able to learn and retranscribe the characteristics of its environment, reconfigure itself, and adapt. Possible uses include as a part of sophisticated computer-integrated manufacturing architectures, in farm environments, or on the planet Mars.

## LASERS, SENSORS, OPTICS

### Germany: Optical Crystal Quality Improved

93WS0428B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 29 Mar 93 p 10

[Article by J.B.: "Codoping Leads to Improvement in Quality of Optical Crystals; Research Projects in Aachen Concentrating on Rare Earth Garnets in Particular"]

[Text] Frankfurt—Impurities in crystals can make them unfit for optical uses. These impurities are often produced by the raw material from which the crystals are grown. Professors Dr. Eduard Woerman and Dr. Matthias Goebbels of the Institute for Applied Crystallography and Mineralogy of the University of Aachen (Templergraben 55, 5100 Aachen) have now developed a method by means of which high-quality crystals can still be grown despite the impurities of the raw material.

As these scientists informed us, the demand for crystals for optical uses has recently been growing more and more. The range of applications involves mainly laser technology and magneto-optical applications. The research projects in Aachen are concentrating on rare earth garnets in particular. These crystals consist of a mixture of aluminum, gallium, and iron oxide combined with rare earth oxides.

The components can be to a certain degree interchanged with one another. In precisely the same way, other cations may also be introduced for doping purposes. But these cations may also behave as unwanted impurities. Ideally, only trivalent cations should appear in the garnets. Bivalent or quadrivalent cations like calcium, magnesium, or silicon ions lead to the formation of flaws.

These flaws in turn cause undesired coloring of the crystals. Since high standards of quality are required for their applications, these kinds of impurities result in crucial limitations on the uses to which they may be put.

Even impurities of only 50 ppm (parts per million) can lower the quality of the crystals.

The Aachen scientists looked into the question of whether an improvement in crystal quality could be achieved through the selective addition of cations (codoping) to impure raw materials. This was studied on the basis of raw material for gadolinium-gallium-garnet (GGG), which was rendered impure with quadrivalent silicon ions.

Bivalent magnesium ions were used for the co-doping. The melting zone process was used as the crystal-growing method. This method of growing crystals without a crucible rules out additional contamination by crucible materials. Since the melting point of GGG is about 1,725° C, a mirror-chamber oven was used.

The oven consists of a gold-plated oven body with a xenon lamp. The homogenized mass of raw material was placed at the focal point of the oven in the form of a ceramic blank and a constantly growing crystal was grown with the aid of a seed crystal. The impurities of the raw material produce additional and unwanted absorption spectra.

Thus, silicon ions, for example, result in a spectrum at a wavelength of 350 nanometers. When crystals containing silicon were co-doped with magnesium, the crystals with an excess of magnesium exhibited the same optical behavior as crystals that were doped with magnesium alone.

With crystals in which an excess of silicon was present, the Aachen researchers were able to demonstrate that codoping to a certain extent compensates for impurities in the raw material and results in improvement of the optical quality of GGG crystals.

### Germany: Nonlinear Optical Material Studied for Lasers

93WS0438A Frankfurt am Main FRANKFURTER ALLGEMEINE in German 28 Apr 93 pp N3-N4

[Article by A. Hardy]

[Text] Conversion of red laser light into blue one is not only an entertaining magic stunt from a bag of tricks in the realm of physics but also something of considerable technical interest. This is so because the wavelength of blue light is half the wavelength of the original laser beam. It thus becomes possible to store optical information within a much more cramped space. So far, however, no material is yet available which would emit the shorter light waves with sufficiently high intensity. The goal of producing new optical data storages for use, say, in compact-disk record players is therefore being approached at a slow pace.

The key to wavelength halving and correspondingly frequency doubling lies in materials with nonlinear properties. Just as vibrating strings generate harmonics alongside fundamental-frequency waves, so does such a material emit a second light beam of a different color. While originally only inorganic crystals were known to produce such an effect, soon electrically polarized organic molecular crystals and polymers were also found to be capable of this. Within the framework of the joint "Ultrathin Layers" project initiated by the Federal Ministry of Research, scientists in the Hoechst Company are now pursuing a new item: they study the possibility of using so called Langmuir-Blodgett layers for nonlinear optics.

Employment of the Langmuir-Blodgett technology makes it possible to achieve the desired thickness and properties of extremely thin films. For this, a thin wafer serving as the substrate is dipped into a trough with water on the surface of which there floats a thin layer of organic molecules. Rod-like molecules are water-attracting (hydrophilic) at one end and water-repelling (hydrophobic) at the other. They therefore orient themselves parallel to one another in a certain preferred direction. When such a substrate wafer is dipped perpendicularly through this layer and further down the trough, a high-quality ordered film will be deposited on its surface. One can control the thickness of this film precisely by regulating the number of dips and the length of the rod molecule.

The more ordered and thicker the film is, the higher will be the intensity of the shorter-wave light. Researchers at that chemical enterprise have, with about 150 molecular layers, attained a light intensity closely approaching the requirement for technical application. Together with chemists at the Technical University of Munich, they are now developing a so-called stream bath which will facilitate treatment by a variant of the Langmuir-Blodgett process for industrial-scale production of such thin films. A continuously running stream pushes the floating molecular layer to the front wall of the trough and thus compresses it. In this way the thin substrate wafer can be coated without a break.

In order for such a film to acquire nonlinear optical properties, it is not sufficient that the molecules in each layer be arranged parallel to one another. It is also necessary that the electric dipoles of molecules in all layers be oriented in the same direction, because otherwise the contributions of individual layers to the desired effect will cancel one another out. When the substrate is covered with only one kind of molecule, then the orientation of the dipoles reverses in each successive layer: when the hydrophobic ends of the rods point upward during immersion of the substrate, then their hydrophilic ends will necessarily move to the very top during withdrawal of the substrate. That is why researchers in Ude Scheunemann's group use a sandwich-like structure of alternating optically active and optically passive layers. For obtaining such a structure, they have developed a further variant of the dipping processes where the substrate is dipped alternately into two different troughs.

The molecule responsible for nonlinear optical behavior of such a film is a dye molecule at whose hydrophilic end electrons will preferentially dwell, inasmuch as some bonding electrons of such a dye are mobile and can migrate from one end of the molecule to the other. Only the resulting nonuniform distribution of electrons will cause the molecule to emit second-harmonic wave together with the excitation-frequency light beam. Unfortunately for the physicists, however, this effect is most pronounced at wavelengths of preferential light absorption by the material. In order to prevent immediate absorption of the just generated new wave, researchers select exciting light of a wavelength which lies near the absorption edge of the dye. The wavelength of the laser is thus prescribed. The search goes on, therefore, for a material with matching absorption characteristics. Optically active films are sought which can serve as frequency doublers for a commercial 830 nm GaAs laser diode.

Researchers at the Applied Physics and Polymer Research departments of the Chemical Enterprise have, for demonstration, developed a waveguide which converts the light of a so called YAG-Nd laser into a green beam. For this, the laser beam is entered into a waveguide consisting of an active Langmuir-Blodgett film. The intensity of the thus generated green light is, however, not yet adequate for technical purposes.

The problem is that the propagation velocity of light in matter depends on their wavelength. This gives rise to a path difference between the original beam and the shorter-wave beam. Their interference causes their waves either to attenuate each other in regular intervals or to amplify each other. Scheunemann and his co-workers are trying to avoid this effect by bleaching the dye in the waveguide segments where the light intensity is minimum. In this way the light beam could be stepwise amplified within regions of constructive interference and its intensity thus reach the level which meets technical requirements.

It cannot be foreseen now whether series production of frequency doublers will ever be feasible. There are still many difficulties involved not only with Langmuir-Blodgett films but also with other materials. Work with inorganic crystals whose nonlinear optical properties were discovered first has progressed the farthest of all. Employment of applicable grinding techniques makes it possible to construct resonators in which the shorter-wave light will be amplified to a technically adequate intensity. For commercial purposes, however, the production of resonators is too costly.

In organic molecular crystal, another class of materials with nonlinear optical properties, there is no need for amplification. Such crystals are, however, difficult to process and can only with great difficulty be formed into narrow waveguides. In this respect electrically polar polymers offer the advantage of simple fabrication at a

reasonable cost. Only a limited number of the electric dipoles in a kinked chain molecule can, however, be oriented in one direction.

In contrast, Langmuir-Blodgett layers can be well oriented and be processed with extreme precision. Only further research will show whether these favorable features can be technically utilized. Three large chemical enterprises as well as several scientific institutes are participating in the joint "Ultrathin Layers" project promoted by the Ministry of Research.

### **Germany: Experts Call for Dialog on Future Technologies**

93WS0438B Frankfurt am Main FRANKFURTER ALLGEMEINE in German 27 Apr 93 p 16

[Article by Stue, Bonn]

[Text] The German industry suffers weaknesses in important key technologies and future areas. The scientific-technical basis is there, but deficiencies are evident in the fast conversion of available knowledge into new products. A wide agreement on this diagnosis was reached by the participants of a conference held by the Friedrich Ebert Foundation on the theme "Innovative Policy for Technology in Present Germany." Relative to the great expectations a state policy would have to meet, it disposes of only limited means. This said Uwe Thomas, Schleswig-Holstein's Minister of Economic Affairs, Technology, and Transportation, "A good Minister of Research is a helper of innovation." A research policy, he said, cannot formulate goals by itself. Its function, he said, is to serve in networking various fields of technology and to utilize their synergies. As an example, the SPD politician cited "informatization" of traffic. Modern traffic control technology has made it possible to manage a 20 percent heavier street traffic and even a doubling of the rail traffic.

Thomas considers promoting young growth-oriented firms so that they will rise to globally active enterprises to be a principal challenge. The taxation system would have to be restructured so as to favor growth and innovation. This goal was seconded by Professor Hans Guenter Danielmeyer, member of the Siemens AG board of directors. He reminded the conference that founders of industrial enterprises had promoted activity in Technology Parks. These will be successful, he said, only when, after a while, individual responsibility is demanded from each. Danielmeyer is convinced that promotion of people who have the knack for innovative enterprise must begin early. "Whoever by completion of studies or by graduation in the state's education system has for 22 or 26 years been trained to aim at security," he said, "is not a founder of a high-tech enterprise."

Danielmeyer agreed emphatically with one concept of a technological policy which a team of experts in science, economics, and politics at the Friedrich Ebert Foundation have developed: where they propose abandoning the directorial idea that the state can provide target-oriented

guidance of technological developments and economic processes. It is nevertheless recommended that the state retain an active role, perhaps in creation of an innovation-fostering environment by way of a highly developed scientific infrastructure and an intense competition on the national market. A principal task for the state is to be organizing and presiding over a coordinated interplay of economic, scientific, and political activities. In the ensuing discussion it was particularly representatives of economic management who deplored the fact that, though many discussion groups are meeting, the so often called for intense dialog has still not taken place. And so Hans-Joachim Hass from the Federal Association of German Industry (BDI) demanded that the work of these discussion groups finally be brought and tied together.

### **Germany: CO<sub>2</sub> Laser Used to Mark Polyester Components**

93WS0439N Toddington NEW MATERIALS INTERNATIONAL in English Feb 93 p 3

[Text] Placing identification marks on electronic components, when large volumes have to be marked in a short time, is now practical using a carbon dioxide laser method with Bayer's Pocan KU 2-7503/1 PBT flame retardant thermoplastic polyester.

Increased demand for markings is arising because of product liability and recycling pressure.

The component made in Pocan is marked with high contrast clearly legible and abrasion-resistant letters at an extremely fast cycle. In addition, this laser-optimised PBT grade not only has the required level of electrical properties, but also good adhesion to the encapsulating compound, and it has the UK 94 V-O flammability rating at 0.8 mm wall thickness that is required for materials used in these applications.

## **MICROELECTRONICS**

### **Italy: Genoa Research Consortium Develops Biomedical Chip**

MI1105142193 Genoa GE.RI.CO. NEWS in Italian Mar 93 p 3

[Text] The biomedical chip project presented in Paris by the Genoa Research Consortium VLSI [very large-scale integration] design center has won the first prize among the 50 industrial projects presented at EDAC-EUROASIC '93, the principal European microelectronics conference held in Paris on 22-25 February.

The integrated circuit has extremely advanced performance levels. It has a 100-Mhz operating frequency and controls the acquisition and reception of a sonograph. It has been developed using European Silicon Structures (ES2) technology and was designed by the Genoa Research Consortium and the University of Genoa Department of Biophysics and Electronics in cooperation with Esaote Biomedica. The chip will be used on a

new generation sonograph by Esaote, which produces and exports sonographs throughout the world.

The chip was developed using EC funds allocated by the DG XIII for the advancement of microelectronics among small and medium-sized industries.

**France: SGS-Thomson Continues 'Chameleon' Transputer Program**

93WS0428D Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 31 Mar 93 p 8

[Article by P.O.: "Inmos Is Betting on Chameleon Program; SGS-Thomson: Emphasis Lies on Broad Range of Modules"]

[Text] London—The European microelectronics combine, SGS-Thomson, is vigorously pushing its so-called Chameleon program. In 1991 and 1992 the British combine, Inmos, developed a comparatively advanced architecture for programmable transputer products.

That was the first part of the Chameleon program, within the framework of which it is anticipated that new kinds of microprocessor products will be developed and marketed "well into the next century," as Prof. David Mays, responsible for these developments at Inmos, recently stated in London.

The concrete objective of the chameleon program is to in the process develop a "cost-effective series of modules that provide support for mass-produced applications with a degree of integration of 10 million transistors." The hallmark of these multipurpose modules will be standardized connection records that, among other things, allow for the integration of several modules into a single VLSI [very large-scale integration] product.

According to Mays, the planned Chameleon module offering includes, among other items, a 64-bit processor with cache, a programmable communications processor, fast communications interfaces and a link router, a floating point coprocessor, and a reconfigurable coprocessor. In addition, special modules for specific areas of application are planned. In connection with this, telecommunication and graphics-video systems are, for example, involved. The architecture interfaces are of some importance with an eye to both hardware and software. At the same time an interconnection record in three versions is planned. Furthermore, there is a virtual binary design that is expected to create the prerequisite for modifying the set of processor commands at particularly minimal expense or if necessary enter a new set of commands.

According to Mays, the whole Chameleon architecture is geared to support standard software. This is especially true for operating systems, compilers, and programming languages.

**Belgium: Mietec's Submicron Chip Plant Described**

BR1205144993 Zellik TECHNIVISIE in Dutch  
Apr 93 pp 23-24

[Unattributed article: "Flemish Chip Manufacturer Expands"]

[Text] Following the commissioning of Mietec's first production unit in 1985, a second IC [integrated circuit] plant is now operational in Oudenaarde. This expansion was necessary because the existing plant—built for three-micron technologies and now using 1.2-micron technology—has reached its limit, both in terms of capacity (140,000 wafers per year) and technology.

As a manufacturer, Mietec keeps close track of technological developments because customers want increasingly fast, energy-efficient, and complex chips. Using current technologies, ICs are lithographically produced with line widths of 1.2 microns. In the new plant, it should be no problem producing chips with line widths of smaller than 0.5 micron. At the same time, the wafer size (IC carriers during production) was increased from four to six inches. This improves cost-effectiveness because handling costs will not increase when production switches to larger silicon wafer sizes. However, the capacity of the equipment will have to be increased.

The first operational silicon [circuit] was produced at the end of 1992. The actual inauguration of the plant took place on 26 April 1992. We talked about the new plant with Guido De Loor, plant and facilities manager at Mietec.

**Rapid Construction**

The application for a building permit was submitted in 1990. In mid-March 1991, the management of Alcatel, which is a 100-percent shareholder in Mietec, gave the go-ahead for the construction activities, which started seven months later. All the engineering, construction, and start-up activities were completed in record time. Within a year the first production tests had already been carried out. By April this year, the first qualification batches from plant two will be ready for customer testing. All that is needed now is the green light from the customer to start full-speed production.

**New Design**

The very stringent specifications of current electronics technology required that the plan for the new production unit be redesigned and improved. Plant two (42 x 84 meters) is therefore 17 meters high, while plant one is only 8 meters high. In plant one, everything is contained on one floor. Both the production equipment and the operators are in the clean rooms. The production support facilities (gas supply pumps, etc.) are in a service corridor next to the clean rooms. Maintenance staff has



to enter certain sections of the clean room for servicing and, if required, repairs, which could allow dust into the clean room.

By contrast, the new plant has two floors. The first floor houses all the production support equipment, such as vacuum pumps, air-conditioning equipment, etc.; the second floor, mounted on vibration-proof pillars, contains the clean rooms. The permanent clean room fittings, such as ventilation, heating, and air conditioning, are in a separate four-story building, with the cooling units on the roof.

Since the production floor no longer contains engines, there is a reduced likelihood of vibration. In contrast to plant one, the clean room equipment in plant two has been moved to the service corridor and is no longer contained in the clean room itself, which only houses the [wafer] loading facilities. Thus, the production equipment can now be serviced outside the clean room. In addition, the clean rooms have been equipped with a comprehensive parallel laminar air flow system, which means that their cleanliness can be kept constantly at a higher level. In order to increase the clean room's potential for extension, it was decided to have its air purified not by one central air conditioning unit, but by 1.2 x 1.2-meter filter/ventilator units mounted one beside the other. In the event of further expansion, the walls simply have to be moved and filter/ventilator units have to be added. Furthermore, the overall pressure drop is smaller, which means a saving in energy and a better laminar flow. The air is discharged under a raised floor. The raw materials for production are supplied through pipes from the room below. This also makes them easier to move, which enhances production flexibility.

Since the quantity of nitrogen required has risen to around 600,000 liters/month, Mietec decided to build its own nitrogen production plant. This unit is based on compression/distillation techniques. In order to build up sufficient stocks for a monthly consumption of 10,000 cubic meters, hydrogen is now stored in liquid instead of gaseous form. This required the imposition of strict safety measures.

### Higher Requirements

During construction, it was decided that all the production-environment-related requirements (cleanliness, stable temperature and humidity levels, etc.) and the process factors (purity factor of raw materials to be supplied, such as gases and water) had to be increased by a factor of between 10 and 100.

Process gases now have to have a purity level measured in ppb (parts per billion) as opposed to ppm (parts per million) and, at an air temperature of 22° C, a deviation of only 0.1 degree is permitted, instead of approximately 1 degree before.

The production equipment has also been improved. These higher requirements are necessary to achieve extremely small line widths (0.5 micron) at economical production costs.

### Monitoring and Security Systems Supplied by Same Subcontractor

To guarantee that all these specifications are met 24 hours a day and seven days a week (Mietec produces non-stop), all utilities must be monitored and automated, including heating and cooling, ventilation, water, and gas supplies. This is no easy task, as demonstrated by the extremely narrow tolerances permissible for temperature, humidity level, and dust content. These are necessary to meet the high clean room purity requirements.

Another example can be seen in the water supply, where the delivery and purity levels of quantities ranging from 600 to 1,000 cubic meters per day have to be monitored. Gas supply is also a complex business. The pressure and temperature have to be monitored, not only of the large quantities of nitrogen and hydrogen, but also of around 80 other gases, such as doping gases, which have to be extremely pure. To guarantee that all this information can be traced, it has to be recorded.

In contrast to previous practice, the control and automation equipment is now installed by one supplier. This should eliminate arguments and misunderstandings if problems arise.

AEG [General Electricity Company (Germany)] was approached for the new plant. They provided the automation and installed a central control and monitoring room, with back-up in the porter's lodge. They also selected and positioned the correct sensors, control equipment, control valves, etc., in the various plant sections. All the security alarms (fire, smoke and gas alarms, acidity alarm) were also included in the contract.

### France: Radar Prototype Developed to Measure Distances Between Cars

BR0705143093 Paris *ELECTRONIQUE*  
INTERNATIONAL HEBDO in French 15 Apr 93 p 36

[Article signed P.A.: "Radar Detector Modules for Automobiles by 1995"]

[Text] GEC Plessey Semiconductors [GPS] has developed prototypes of 77-GHz radar detector modules to control the distance between automobiles or other mobile devices. A market for this could get off the ground by 1995.

You are calmly driving your car at a safe distance from the vehicle in front of you. Suddenly, it slows down. Without any action on your part, your car also slows down, and then accelerates as soon as the car in front of you regains speed.... Science fiction? Not really. Five years from now, it may be possible to cruise the highway in top-of-the-range vehicles equipped with AICC

(Autonomous Intelligent Cruise Control) radar systems capable of controlling the distance between vehicles. GEC Plessey Semiconductors has already perfected several dozen prototypes of these radar modules under the watchful eye of most automobile manufacturers.

One year ago, the European Radio Communications Committee even assigned the 76-GHz band for vehicle-mounted radars, which serves as proof that the applications are in no way futuristic.

The technology implemented by GPS is in fact a spin-off from the company's missile tracking radar technology operating at 94 GHz. Of course, the aim is no longer to detect and destroy moving targets, but to ease road traffic, particularly on crowded highways, by adapting the speed of one vehicle to that of others within radar range. GPS has therefore developed an FM-CW (continuous-wave frequency modulation) radar detector operating at 76.5 GHz, which can easily be mounted at the front of an automobile due to its small size (7 x 7 x 10 cm). Closed, it looks a bit like an automobile headlight. It uses no wave guides or horn-shaped emitter; the energy, supplied by a Gunn oscillator, is transmitted to a "plate antenna" via a microstrip circuit, a technology able to withstand difficult conditions. In practice, a 5-mW beam is emitted by a dielectric polypropylene lens in a 10-degree cone. The energy is reflected by the target vehicle, and then picked up again by a second lens in three beams of 3 degrees each to obtain a better image of what is happening ahead of the vehicle. The electronic scan of the three beams takes just 15 ms.

Using the respective frequencies of the signal transmitted and the signal reflected, the detector calculates an intermediate frequency between 2 and 200 kHz, for a maximum range of 100 meters. The intermediate frequency is then related to the distance and speed of the vehicle followed using a function which depends on the type of modulation (ascending ramp, descending ramp, etc.). An oscillator feedback loop located on the microstrip circuit guarantees modulation linearity precision within 0.5 percent.

The radar detector can be linked to an electronic signal-processing device (sampling, analog-digital conversion, Fourier transformation), which supplies digitized information with a precision of approximately 1 kHz (or approximately 25 cm) via an RS/232 link.

#### **European and U.S. Manufacturers Already at Work**

Building a complete system will take two further steps, however, which will be up to the automobile or equipment manufacturer (for example, the ABS [antiblock] systems supplier): First, the development of a rather sophisticated processing algorithm (the system must be able to distinguish between a car and a bridge, for example) and, secondly, the development of system for the automobile's accelerator-brake control.

GPS says that most European and American manufacturers are already working on this (GPS will supply a few

dozen prototypes this year), while a practical demonstration has already been completed using a Jaguar vehicle. (Jaguar is working on a longer-range project with GPS in the context of the European Prometheus CARE (Collision Avoidance Radar Equipment) program. This program not only deals with driver comfort, but also with safety, and the algorithms are much more complex. According to GPS, such systems will not appear on the market within the next 10 years.)

Between mid-1993 and mid-1994, GPS intends to produce approximately 200 units at its factory in Lincoln [England]. If the market proves receptive, several hundred thousand units will be produced beginning in mid-1995.

According to GPS, the price of the radar detector in the mass production phase should not exceed 1,000 French francs.

#### **Germany: Superconductor-Based Magnetometer Developed**

*M11105124093 Stuttgart LASER UND OPTOELEKTRONIK in German Apr 93 p 9*

[Text] The Information Technology Research Company [PIT] has developed high-temperature superconductor-based magnetometers that for the first time make it possible to measure the local distribution of magnetic field strength on the surface of a rock sample. Only the overall magnetization of a sample had previously been measurable. Fine lateral local resolution of 2 mm was achieved in measurements performed on a paragneiss drill core from a depth of 2,306 meters under the Federal Republic of Germany's Continental Deep Drilling Program [KTB] at Windscheschenbach (Upper Palatinate).

#### **Germany: European Liquid Crystal Display Activities Increased**

*M11105125693 Stuttgart LASER UND OPTOELEKTRONIK in German Apr 93*

[Text] Display technology, like microelectronics one of the major key technologies for information technology as a whole, is a market that holds out great potential for European firms to increase their share of the world market for LCDs [liquid crystal displays], which is, however, only around 5 percent (compared with over 90 percent for Japan). The decision by Philips to build a new flat LCD display factory in Eindhoven offers grounds for hope that Europe will remain a production center for LCD displays. The Display Technology Laboratory set up at Stuttgart Technical University in conjunction with the Land of Baden-Wuerttemberg, and the world lead enjoyed by a number of chemical firms in LCD know-how, provide excellent prospects for Germany as a research base. Over the next year, the German Aerospace Research Institute [DLR] will set up a strategic working party, which will be open to all interested firms and research facilities.

## NUCLEAR R&amp;D

**French-Dutch Superconductive Cyclotron Presented**

93WS0455J Zoetermeer *SCIENCE POLICY* in English  
Apr 93 p 24

[Text] A unique new machine for the acceleration of atomic nuclei will go into operation in the Netherlands this year. The Accelerateur Groningen Orsay—or AGOR for short—will be located in the Nuclear Physics Accelerator Institute (KVI) at the University of Groningen. The accelerator is currently receiving its finishing touches in Orsay, France.

AGOR is a joint venture between the Foundation for Fundamental Research on Matter (part of the Netherlands Organisation for Scientific Research) and the French National Institute for Nuclear and Particle Physics. The accelerator will be ready in the spring. Later in the year, it will be moved to Groningen for use in nuclear physics and related research.

A cyclotron uses coils through which an electric current is running to generate a strong magnetic field which must be constant over a distance of some metres. The magnetic field ensures that the electrically charged atomic nuclei in the coils remain enclosed in the cyclotron, even when they are being accelerated. The superconductive coils used generate much stronger magnetic fields than normal coils, allowing the atomic nuclei to be accelerated to much higher energy levels.

AGOR differs in two ways from other superconductive cyclotrons in that it can accelerate very light atomic nuclei—such as those of hydrogen—as well as heavy ones. This is thanks to the special shape of the coils and the magnetic poles.

The technique used in constructing the coils is one that has previously been used only in the construction of smaller coils. Superconductive coils of the size used in AGOR (diameter 2.6 m, height 0.5 m) have previously consisted of a large number of separately wound layers, impregnated for isolation, which are then stacked like pancakes with small spaces separating them. The spaces contain liquid helium, which keeps the coils superconductive by cooling them to very low temperatures. By contrast, AGOR's coils are wound in one unit and then impregnated with epoxy resin. The liquid helium for cooling the coils is therefore external to them. This makes the coils mechanically much more rigid, thereby enabling them to withstand the strong Lorentz forces generated in the strong magnetic field of 4.02 tesla (international unit of magnetic electricity).

This also reduces the chance of short circuits between the loops. The coils were recently turned on and tested—with no resulting problems.

## TELECOMMUNICATIONS

**Italy: Alenia Spazio Develops Mobile Satellite System**

M10206133493 Rome *SPAZIO INFORMAZIONI*  
*SPAZIO ITALIA* in Italian Mar 93 pp 20-21

[Article by Eng. Francesco Rispoli of Alenia Spazio, head of the ESA market: "The Cellular Telephone Via Satellite Has Arrived"]

[Text] Everybody knows how much mobile telephones are used and how the service has developed everywhere, particularly in Italy. Italy has in fact registered the highest growth rate and ranks fourth in the world with 800,000 subscribers. Experts foresee a continuous increase in the use of mobile telephones using more and more sophisticated systems that are specialized to suit the various types of subscribers. We are therefore passing from national systems to transnational systems such as the GSM [Special Mobile Group], which will enable personal telephones to be used in European countries, to systems that will enable us to travel around the world with our mobile telephones.

In this field a satellite is able to complement the traditional system on land when it is necessary to supply wide coverage as well as a specialized service for certain categories of subscribers, such as transport companies including train and aircraft operators, needing to communicate both with their own vehicles (closed circuit system) and with the external world using the telephone network.

**European Mobile Satellite System**

The European Mobile Satellite (EMS) system of the European Space Agency (ESA) began because of this and a preoperational service is scheduled to begin in 1995. The Italian communications satellite Italsat-F2 will in fact be launched during 1995, carrying the EMS that is being built by Alenia Spazio. Alenia Spazio heads the industrial consortium that includes, amongst others, Matra Marconi, ComDev, Ericsson, CASA [Aeronautic Constructions Company], and Siemens.

The EMS will cover a wide zone including Europe, North Africa and some eastern European countries in one single band (or cell), thereby avoiding shadow zones such as those typically excluded by land-based mobile radios because of low population density which makes them insufficiently remunerative in consideration of the required investment. In this respect the EMS could be of valid help to the transport companies that foresee an intensification of interchanges with the eastern European countries that lack telecommunications infrastructures and do not have cellular networks. The EMS lends itself as a concrete means of starting cooperation with the eastern European countries as part of the obligations that the European Commission has recently undertaken to help the development of their economies.

On the other hand the EMS is not starting off alone in the world. Similar initiatives are under way in the United States and in Canada with the joint M-Sat program, and in Australia with a system that is very similar to the EMS that will be put on board the satellite Aussat II. The typical subscriber target of the EMS is the transport company that has at least 10 vehicles travelling medium-to-long distances across several European countries. According to recent market studies there will be more than 5,000 transport companies in Europe in 1995, each having between 50 and 500 vehicles.

Most of these will be served by land-based cellular systems (GSM), but about 10 percent would certainly find a system via satellite advantageous. This percentage corresponds to over 500 companies having a total of between 30,000 and 40,000 vehicles equipped with radiotelephones operating via satellite.

The architecture of the EMS system comprises a land network, composed of mobile terminals (MSBN) for bidirectional connection with the satellite, and a fixed station (FES) situated within the offices of the companies that will have one or more satellite channels available (it is in fact possible to serve about 100 subscribers with one channel). The management of the calls and the assignment of the channels and relative charges will be entrusted to the control station (NCS).

The space segment consists of a transparent type repeater that receives the calls from the mobile subscribers in L band (1.5 GHz) and retransmits them back to earth in Ku band (13 GHz). In the opposite direction, the calls from the earth station in Ku band are sent to the mobiles in L band.

The EMS that will be carried by the Italsat-F2 satellite, weighs 43 kg and will need about 300W. More than 80,000 mobile subscribers can be served by this configuration for traditional telephone calls, data communications and/or telex.

Therefore, the Italsat-F2 satellite will have a double function, having also to perform its principal telephone mission at 20/30 GHz over the national territory, which is carried out today by its twin that has been in orbit since 1991.

#### Development Prospects

The EMS program can be considered as a concrete example of the use of satellites for communications between mobile units, even though an experimental stage is necessary before it becomes a service that will attract the operators' interest. Furthermore it is necessary for a decisive development of the land-based segment to follow parallel to the development of the space segment. It is foreseen that the land-based sector will be of greater interest from an industrial point of view.

The analyses that have been conducted so far show the service to be highly profitable particularly if it is considered in relation to the modest use of resources by the

satellite. The EMS, in fact, has the same consumption as two television channels. The difference is that the returns are estimated as being between eight and 10 times greater. The cost of a one-minute conversation would vary between ECU0.5 and ECU1. This is certainly comparable to, if not competitive with, the land-based system.

The commercial spin-offs when the EMS comes into service are therefore quite promising and will be able to be taken up by European industry, that until now has often had to give precedence to the Americans and Japanese, who have taken advantage of the economies of scale to defuse their own land stations in Europe. Investments in the space sector could therefore generate a return that is five to eight times greater than that of the land sector (a mobile terminal, in fact, should cost about ECU5,000, while a fixed station should cost about ECU50,000) as well as the returns for the operator who manages the service.

With the EMS, Europe has shown its desire to develop a new telecommunications service. Thanks mainly to the agreement of the Italian authorities, it has been possible to combine the EMS and Italsat-F2, without which the latter would have had to sacrifice its first mission.

#### Germany: Optical Telecom Fibers Built Into Power Cables

MI0206082093 Bonn DIE WELT in German  
15 Apr 93 p 9

[Article by Peter Borg: "Telephone Conversations Down High-Voltage Lines: PreussenElektra Pioneers Use of Overland Cable With Built-In Optical Fiber for Telephone Calls"]

[Text] High-voltage lines have hitherto been used exclusively for carrying electricity, but they are now also being used for the first time to transmit information along an overland line. Near the North Hesse city of Kassel, the PreussenElektra [Prussia Electra] electricity corporation is testing a new type of electrical cable that can truly be said to have inner potential. The center of the line, developed by Feiten & Guillaume Energy Technology (F&G) of Cologne, contains a stainless steel tube filled with 36 optical fiber strands, along which PreussenElektra has fed its internal communications in unprecedented quality. F&G's Joachim Bausch explains the advantages as follows: "Before the introduction of optical fiber technology, electricity corporations normally transmitted their internal communications via radio link, with all the attendant problems of high attenuation, electromagnetic interference, and limited range. Now that is all a thing of the past."

After years of experience with ground current cables, which have to date also had integrated optical fibers for data transmission (for example to North Sea oil platforms or to excavators on opencast brown-coal mines), the Cologne engineers hit on the idea of carrying both electricity and information along the same strand. In the



Kassel pilot project, one wire from a 110-kV high-voltage cable was replaced by optical waveguides, thus retaining the cable's overall structure. The transmission line's electrical and mechanical properties are not altered. The new type of cable with its optical fiber core can thus readily be substituted for a conventional cable without recalculating the pylon's statics, a complex and expensive job.

As glass and metal expand at different rates when heated, an optical fiber is slightly longer than a metal wire to compensate for any mechanical stress, say the manufacturers. F&G have developed new launching and output fittings whereby the optical fibers can be separated from the high-voltage conducting part of the cable at the start and end of a line.

This can be achieved using special isolators weighing around 80 kilograms, which can be internally re-expanded with foam. Following PreussenElektra's initial positive experience, F&G's development department is already considering replacing several high-voltage wires with tubes containing optical fibers, which would dramatically increase transmission capacity. The Federal Materials Testing Agency in Berlin is therefore currently studying how this substitution could be achieved without altering the mechanical properties of the high-voltage line.

Electricity corporations are still prevented by the telecommunications monopoly from using their lines for any other purposes than in-house communications. The policymakers have, however, declared their intention of ending this monopoly within five to eight years. Since the beginning of this year, companies have been allowed to communicate with their own subsidiaries via their own lines. When the license for a third digital mobile phone network (E-1) was awarded to a Veba-Thyssen consortium in February, Veba's head office in Duesseldorf referred to "extensive experience with in-house communication networks, using both line transmission and radio links." Private telephone conversations along high-voltage lines could thus soon cease to be a pipe-dream.

#### **Germany: DBT To Improve Data Handling Capacity**

93WS0428A Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 26 Mar 93 p 8

[Article by Bernhard Rose: "People in Field can Operate Faster and More Accurately With Instant Radio Link; Telecommunications Division of German Postal Service Introduces Modacom Radio-Transmission of Data As Regular Service; Motorola Introduces Laptop Radio Modem"]

[Text] Hannover—The Telecommunications Division of the German Postal Service will be further developing its mobile data-transmission service, Modacom, and introducing it as a regular service before the year is out. To

accomplish this, 900 fixed stations are to be set up by 1995 as combined transmitter-receiver units, with which about 80 percent of the blanket coverage will probably be attained. Users will in future be able to exchange computer data and electronic mail (E-mail) throughout Germany over this radio infrastructure, for example, via mobile transmitter-receiver computers equipped with radio modems, which the Motorola Company is setting up for the Telecommunications Division on a DM260-million order. It will result in completely new applications. Up to now, the pilot project begun in the first half of 1992 has covered Germany's most important economic centers. By the end of this year the areas alongside the freeways should be added to them.

For wireless data transmission or E-mail messages by radio via the Modacom service, Motorola has now created a special radio modem for connections with portable computers like laptops and notebooks. What was up to now only possible via acoustic couplers or telephone lines—to, for example, pass on reservation information from a hotel room to a mainframe computer or to elicit information from a data bank from the room via Datex-P—is now expected to also be possible by radio while on the road to provide nearly blanket coverage throughout all of Germany by 1995.

According to Motorola, field organizations and service employees, sales, and distribution are the markets that are to be targeted for the new radio modem. According to Motorola, no less than 40 percent of the workers employed in the industrial countries today already have a mobile workplace or are often on the road. Other applications are the automatic transmission of, for example, telemetry data like measurements, environmental readings, for example, and the payment of taxi bills with credit cards via radio.

Independent of networks, the all-purpose radio modem dubbed Infotac will probably cost barely DM2,900 and it is hardly any bigger than a dictation machine. In addition, it contains a pager for the transmission and reception of standard messages. The light, 450-gram device will be shown for the first time in Hannover at the CeBIT. Motorola will also exhibit there what it claims to be the smallest radio modem in the world, in the form of a built-in circuit board for future notebook computers. With it, a portable computer and mobile communication will for the first time be available in a single device. For Heinz Welcher of Motorola, Ltd., in Wiesbaden's Mobile Data Division, fundamentally new applications are arising with Infotac. Thus, a wholesale delicatessen supplier in Bonn has been using the radio modem in test operations for some time now. The employees in the field who deliver the products ordered the day before to restaurants now enter new orders into a laptop right on the spot and radio them directly to the head office.

Whereas before orders could not be processed before the afternoon and it was not certain whether products could be obtained in the desired amounts, now customer

satisfaction has greatly increased because of the early placement of orders and the saving in time.

The monitoring of competition among retailers has also opened up entirely new possibilities. Thus, company representatives can instantaneously radio the competition's bids to their own main marketing office from right on the spot. There, the product manager immediately gets an updated picture of the competition's regional price bids from detailed reports. If the price set by one's own company rises above the competition's price, this can be immediately radioed back to all the representatives in the field via Modacom by E-mail and a conference call.

But service organizations will also profit from Modacom. According to Welchering, surveys conducted at a big EDP company in Germany showed that its own service technicians make calls up to 50 percent more frequently than its customers do. In the process, they asked employees whether there were spare parts in stock, about mistakes that required a fairly long time to correct, about rearrangements, delays, and things of that sort.

Up to now, all this was associated with enormous waiting periods, busy telephone lines, or not immediately available contacts. The company, which annually spends about DM18.5 million to organize its approximately 2,000 service technicians, hopes to increase its competitiveness through the Telecommunications Division Modacom service and the new opportunities created by E-mail communications and remote interrogation of data banks via laptops and radio modem. The savings realized in these operations will altogether (that is, not only in field services alone) probably amount to over 60 percent, or DM11.5 million a year.

Another example is the local taxi organization in Copenhagen. For four years now, it has been running its own data-link network. Since then, the passenger can pay with a credit card as well. The card is checked as with the EC card machine, the passenger's personal identification number (PIN) is entered, and the amount debited.

In addition, all of the 900 taxis get their fare assignments through a mainframe. For this purpose, the addresses to which the cabbie is to drive are entered into a computer at the head office. The mainframe determines which taxi may be available next, sends it to the address, while the driver acknowledges receipt of the instructions. The head office's operating costs, which are mainly for personnel, have dropped by 30 percent.

Welchering expects this to gain similar acceptance in Germany too. But, with the blanket coverage infrastructure provided by the Telecommunications Division as operating authority, investments by interested organizations do not apply.

In the United States the soft drink manufacturer, Coca-Cola, for example, is equipping its machines with radio modems. These devices automatically transmit not only how much stock is left in the machine to the appropriate

office, but also the external temperature, the date, the time of day the reading is taken, and which kinds of soft drinks are most particularly in demand. The arrangements and automatic planning of the routes for the refill trucks are made in accordance with all this.

It is also conceivable that milk tank trucks, provided with similar analyzers, can already radio data on the fat content of the milk to the milk-processing plant via Modacom during the pickup trip from the farmers to the dairy. They will know there even earlier than now whether more cream, butter, or skimmed milk is to be produced on that particular day.

#### **Germany: Daimler-Benz Develops Fastest Silicon Transistor**

93WS0428C Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 30 Mar 93 p 8

[Article by R.E.: "Silicon Transistor Achieves World Record; Daimler-Benz Thinks Further Increases in Speed Are Likely"]

[Text] Frankfurt—Researchers at Daimler-Benz in Ulm have developed the fastest silicon transistor in the world. The company reports that it can process frequencies up to 91 gigahertz and that further increases in speed are likely. This kind of faster transistor is important to Daimler-Benz because it is developing new possibilities in communications technology with the transmission of very large amounts of data and with radar technology. The transistor shows little evidence of noise, a high degree of linearity, and low power consumption. These qualities would also be advantageous with mass applications in connection with the use of mobile communications.

Daimler-Benz mixes germanium in varying portions into the basic material. The company further says that this permits them to alter the electronic properties of the semiconductor as required. The premise for the creation of such "supercrystals" is the strictly regular arrangement of the atoms, which cannot be interfered with despite the addition of atoms of other sizes.

Based on this principle, completely new functions and achievements would be available to the standard material of microelectronics. Conventional logic circuits could, for example, be integrated into the same chip with high-frequency components.

According to what it says, Daimler-Benz is taking a different approach from the one that is commonly pursued. While the classic chip technology tries to make the lateral dimensions of storage and processor structures smaller and smaller to integrate more and more components into the smallest amount of space, Daimler-Benz is looking for improvement in the third dimension. They customize the structures of the inner layout. Layers only a millionth of a millimeter thick were laid on top of one

another here with varying atomic composition. They work with structures that are only 150-200 atom layers thick.

Daimler-Benz believes that with the step into the third dimension they were able to avoid the enormous increases in costs that are incurred in the conventional development of the silicon technology involving reduction of the lateral dimensions.

### **EC: Seven Operators Join Cross-Border ATM Pilot Project**

*93WS0441B Chichester INTERNATIONAL TELECOMMUNICATIONS INTELLIGENCE in English 12 Apr 93 pp 1, 3*

[Text] A further seven European public telecommunications operators have signed the Memorandum of Understanding to implement a pilot Asynchronous Transfer Mode (ATM) Virtual Path Infrastructure across Europe. The seven operators—Belgacom, Telefonos de Lisboa e Porto, Swedish Telecom, Telecom Finland, Swiss PTT Telecom, Norwegian Telecom and PTT Telecom Netherlands—join the initial Signatories of the MoU which are BT, DBT, France Telecom, STET/ASST, and Telefonica (see ITI Issue 364).

Each PTO will procure ATM cross-connect equipment conforming to the available CCITT recommendations and ETSI standards and to EURESCOM specifications. A spokesman at France Telecom told ITI that his company, and as far as he is aware all other participating PTOs, had not made a decision yet on which manufacturer(s) will supply the ATM equipment for the pilot. The process of selecting a supplier has started with several manufacturers being asked to submit their proposals and equipment for evaluation. A decision is expected by the middle of this year. Preliminary ATM VP network trials involving pilot users in each of the participating countries are scheduled to take place in 1994.

EURESCOM—the European Institute for Research and Strategic Studies in Telecommunications—was formed in March 1991 by 20 PTOs from 16 European countries. It was created to co-ordinate strategies for the introduction of telecommunications services on a pan-European scale.

### **France: HD-SAT HDTV Transmission a Success**

*93WS0472B Paris AFP SCIENCES in French 22 Apr 93 p 13*

[Unattributed article: "HD-SAT [High-Definition/Satellite] Project: Successful Demonstration of Digital HDTV [High-Definition Television] Satellite Transmission"]

[Text] Paris—A demonstration of digital HDTV satellite transmission in the 20-gigahertz [GHz] frequency

band was successfully completed in Turin, as part of the HD-SAT project, the Alcatel group announced on 20 April.

Organized by the RAI [Italian Broadcasting Company] research center, with the assistance of the ESA [European Space Agency] and Telespazio, the experiment confirmed the forecasts of the design and engineering department, demonstrating that the 70-bps [bits per second] pictures transmitted by the Olympus satellite and the studio 340-bps quality-reference signal were of equivalent quality.

HD-SAT, the project leader of which is Alcatel Space, is a three-year project that is part of the European Commission's RACE II program [Research and Development in Advanced Technologies for Europe]; the goal of RACE II is to study the feasibility of a satellite system to broadcast HDTV programs in the 21-GHz frequency band. The study will include satellite transmission, either directly to households, or through a cable network.

### **Netherlands: University Studies Use of Plastic for Data Transmission**

*BR1105090693 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch 23 Apr p 1*

[Unattributed article: "Plastic To Replace Glass Fiber for Data Transmission"]

[Text]

### **Monitoring and Security Systems Supplied by Same Subcontractor**

Groningen—Researchers at Groningen University are working on Perspex fibers as an alternative to glass fiber.

Under the auspices of the Netherlands Foundation for Chemical Research, Groningen University is researching the plastic's data communication potential. The project has a budget of 1 million guilders and should result in a technique which is ready for production by 1997 at the latest. The research is already being closely followed by Philips, Akzo, Océ, and the PTT [Netherlands State Telecommunications Operator]. Plastic fibers are less transparent than glass fibers and are suitable for transporting data over distances of up to a maximum of 100 meters. Possible uses include cabling, for example in photocopiers, cars, and small local area networks. Bending tests have shown that plastic fiber is significantly stronger than glass fiber. Connections or links are very easy to make, because the plastic fiber is produced using a molding process.

## SCIENCE & TECHNOLOGY POLICY

**Romania: Government Official on R&D Prospects**  
*93WS0459A Bucharest STIINTA SI TEHNICA*  
*in Romanian Mar 93 p 7*

[Interview with Doru Dumitru Palade, minister of Research and Technology, by Ioan Albescu]

[Text]

[Albescu] Mr. Minister, could you first clarify some points for our readers. Due to publishing schedules, our magazine could not carry an interview immediately after the appointment of the new management team in the ministry which you are heading, as our daily and weekly colleagues were able to do. As a result, we want to examine long range questions associated with scientific and technical development through the role which the Ministry of Research and Technology is assuming in this respect. Could you therefore define your position on the legislative framework for protecting and exploiting scientific and technical creativity, and your intentions for its future improvements?

[Palade] We are conducting a number of studies in this respect, especially since the matter is rather complex and requires careful research as well as measures based on thorough analysis.

As you know, we currently have an invention law formulated by OSIM (State Office for Inventions and Trademarks) and adopted by Parliament, which certainly represents a major starting point. OSIM has already received a number of proposals for complementing or modifying the law; these proposals are based on the experience gained during the brief application of this law, and could be brought up for discussion after some time depending on Parliament's agenda priorities.

Another aspect of the problem is the legislative regulation of activities carried out by the industrial advisor stipulated by the law on inventions. OSIM is working in this respect—and we will become involved in turn—to create the best framework for protecting and exploiting scientific and technical creativity.

One more concern is to improve the utilization system for the special fund for scientific research. Initially, the system was designed for the results of research financed from the fund to be made available at no charge to various economic entities by the respective industrial department, according to its own strategy. Although brief, the time during which this system has been implemented has disclosed some shortcomings, or more accurately, some malfunctions. For instance, there is a need to establish a stimulative response to scientific creation activities, as a function of the results of their practical implementation. Thus, we believe that a percentage of the profits obtained by economic entities from the implementation of research results should return to those who performed the research.

One problem which has not yet been satisfactorily resolved is the protection of software programs, for which rigorous regulations still do not exist—just as for video cecitis, in fact—to secure against copying and use by others. But we know that the Ministry of Culture is intensively working on a cultural heritage law—which could also include scientific and technology aspects—with the support of specialists. But we must first of all consider the specific nature of our development, and adapt to our current and future situation various types of legislations from countries with a rich experience in this activity.

[Albescu] Independently of the contradictory opinions voiced recently, there is one fact that cannot easily be questioned in Romanian scientific and technical research: we have notable traditions in this area, as well as a highly valuable professional potential. Since many Romanian researchers have been moving abroad for various reasons, could you tell us how you perceive this situation and what solutions you feel could be used to counteract it.

[Palade] The same question was asked at the first press conference we held after the formation of the new government, as well as on other occasions, at times even more dramatically phrased as a "true hemorrhage of specialists," but I must say that based on data obtained directly from research institutes, matters are not as serious as some would like to believe.

Information from 222 research and development units in the network and 14 fields of activity, covering 40,198 persons with advanced studies, the great majority of which are scientific researchers, has shown that 446 people have emigrated during the past three years, in other words, slightly more than 1 percent. The situation differs among fields: more than 10 percent have thus emigrated from some branches, and none from others. At the same time, I can respond here to the question raised by Petre Junie in the paper ROMINIA LIBERA; I can say that the migration of research personnel toward other areas of activity in the country is indeed true and rather significant. There are many researchers who preferred to abandon this activity for other, more lucrative ones, especially during 1990 and even 1991. Valuable personnel was thus lost. If the research activity would have been supported in 1990 as it is now, this situation would not have assumed such proportions. Nevertheless, we feel that the 40 percent indicated in ROMINIA LIBERA is somewhat exaggerated.

I might add that many among those who left did not have talent or aptitude for research, specializing instead in product development, and realized that their activity would not be in great demand until massive investments were resumed.

As for emigration, I must acknowledge that for very well-trained specialists, foreign offers are without competition here. We cannot afford to offer the same salaries or working conditions as those offered by prestigious



firms abroad, but I repeat, this is true for a very small number of very well trained specialists.

**[Albescu]** Schools and specialized publications, including those that popularize science, play an unquestionable role in the training of future scientific research personnel. What are the Ministry's plans for expanding the motivational role of technical education among young people at the age at which they make professional choices?

**[Palade]** As you know, the Ministry of Research and Technology has adopted, if I may say so, the Technical Publishing House and the Science and Technology Society, exactly in order to support them and provide an orientation consistent with the strategy we are evolving to develop and utilize scientific research in Romania.

Moreover, from the special fund for scientific research, we support research units in the editing of their own publications, so that we may enter the international exchange of specialized journals at the level expected in this area. At the same time, through the commission specially formed at the Ministry of Culture, we support technical and scientific literature for all publishers involved in that field. The commission also includes representatives of our ministry to direct the promotion of quality technical and scientific publications.

However, this considerable financial effort dedicated to technical and scientific literature is taking place against the background of our economy's financial crisis. We must not overlook our duty to channel significant funds to provide our research institutes with the necessary equipment, an effort that has not been made for the past three years. We hope to find the best solutions for all of these problems.

## AEROSPACE

### Brazil: Space Program Outlined

93WS0431B Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 31 Mar 93 p 8

[Article by "OEL": "Brazil Wants to Develop Its Own Space Program. SCD1 Satellite Is Acquiring Environmental Data. Three Satellites to Follow. Over 30 Monitoring Stations"]

[Text] Frankfurt—The first satellite built by Brazil itself was recently launched from the Kennedy Space Center in Florida. It is called SCD1 (Satellite Data Acquisition Satellite) and is to collect important environmental data in real time, so to speak, from all of Brazil and Brazil's Atlantic coast. This includes changes in the concentration of carbon dioxide and ozone, in order to detect and be able to locate fires deliberately set for clearing, especially in the northern dry regions. The measurements themselves are being made on the earth through more than 30 monitoring stations distributed over the entire country. They transmit their data to SCD1.

Furthermore, meteorological information like barometric pressure, temperature and relative humidity is being acquired from five monitoring stations in the northeast provinces (Ceara) and in the entire Amazon region. They want to use these data for rapid aid measures for the provinces often hit by periods of drought. Variations in gigantic water reservoirs can now be tracked precisely in the Amazon region.

The satellite weighs 115 kilograms. It produces its electric power of approximately 100 watts by means of solar cells that are fastened to the walls of the octagonal spacecraft. Measuring approximately one by one meter, it is a question of a comparatively small satellite. It is stabilized by its own spin during its flight through space. Data transmission takes place in the microwave S band through 160 transmission channels and a standardized digital communication protocol.

The satellite was not launched from the earth by means of a rocket, but from on board a B-52 airplane of the American NASA space agency, which brought to an altitude of 13 kilometers the satellite mounted on a Pegasus rocket. The rocket was fired at this altitude. It shot SCD1 into an orbit at an altitude of 750 kilometers.

SCD1 circumflies the earth in an elliptical orbit, and its orbit is designed to have a little less than 10-percent dip toward the equator so that it flies mainly over just Brazil and the South American continent. The satellite is the first of a series of four satellites that are being planned, developed and built within the Brazilian space program from 1979.

This is an approximately \$280-million program. In addition, it provides for the development of its own rocket launching system and the construction of a launching

site in Alcantara (Maranhao in North Brazil). The space program is being administered by its own space ministry created for the purpose.

With further growth of the space program it will be possible to also track variations in other pollutant gases in the atmosphere (methane, carbon monoxide, nitrous gases). It will soon be possible, together with other partners, to register also changes in the forested areas of Brazil. This project was decided on in 1992 at the world climate conference of 154 countries, in order to get a better survey of areas of the world whose forests can contribute to reducing carbon dioxide in the atmosphere, INPE [Instituto de Pesquisas Espaciais (Space Research Institute)] reports (Sao Jose dos Campos, Brazil/NPE, Sao Jose dos Campos, Brazil).

## LASERS, SENSORS, OPTICS

### Israel: Researchers Develop Gallium Arsenide Infrared Sensors

93WS0431C Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 31 Mar 93 p 8

[Article by "OEL": "New Quantum-Semiconductor Structures Get Along With Less Cooling. More Efficient Infrared Sensors Plus Signal Processing on a Chip"]

[Text] Frankfurt—The today largely perfected gallium arsenide technology, according to more recent development work by Israeli physicists at Hebrew University in Jerusalem, makes it possible to make more efficient and less expensive imaging infrared sensor systems than those based on mercury - cadmium telluride. A large number of infrared sensors can be produced in the form of complete arrays on a chip by means of this process.

Besides, the signal-processing circuits can also be accommodated on the same chip. The circuits produced in the laboratory operate in the middle infrared region of the spectrum between wavelengths of 8 to 14 micrometers.

In spite of excellent images, the sensors used thus far had several shortcomings associated with them. Relatively long signal-processing times, poor image contrast, great temperature dependence and high sensitivity to mechanical influences number among them. High production costs, including to protect these sensors mechanically, had to be accepted in order to offset this. The experimentally produced gallium arsenide detectors bring about high image quality because they are designed with "quantum-well" (QWIR) structures. Here it is a question of well-like layered structures that keep electrons "locked up" so that their energy can now be used.

Experience in the construction of semiconductor lasers, modulators or so-called PIN diodes (semiconductor diodes), in which this quantum effect is also utilized, can be fallen back on for the production of gallium arsenide detectors.

The experimental type available today utilizes an advanced basic structure of QWIRs that is produced both by molecular-beam epitaxy and by metal-organic chemical vapor deposition (MOCVD) processes. The detector structures are each a total of 50 by 50 micrometers large and are based on the standardized two-micrometer raster structure.

Test measurements showed that the sensors can be operated with very strong amplifiers, display very low reactive current and have very fast reaction times. In order to achieve the best possible imaging, it is possible to operate in the temperature range of higher than 80 kelvins (50 kelvins for mercury - cadmium telluride). The cooling effort required can be kept lower by this means.

It is planned in the near future to construct a sensor having 256 by 256 detectors in the form of an array together with the signal-processing circuit for it on a single chip. Then comparisons are to be able to be made between it and the conventional infrared system.

Besides military purposes for target acquisition and reconnaissance, the new systems can be used for non-invasive diagnosis of breast cancer and other cancer diseases, for checking building insulation, for infrared images, for monitoring large electrical plants, or in environmental protection, for detecting large-area fires from satellites for example, reports the Hebrew University of Jerusalem (School of Applied Science and Technology, Division of Physics, Jerusalem 91042, Israel).

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